AMERICAN RAILROAD JOURNAL,
AND ADVOCATE OF INTERNAL IMPROVEMENTS

PUBLISHED WEEKLY, AT NO. 132 NASSAU STREET, NEW-YORK, AT FIVE DOLLARS PER ANNUM, PAYABLE IN ADVANCE.

D. K. MINOR, EDITOR.] SATURDAY, MARCH 19, 1836. [VOLUME V.—No. 11.

CONTENTS:

AMERICAN RAILROAD JOURNAL.

NEW-YORK, MARCH 19, 1836.

REMOVAL.—The Office of the RAILROAD JOURNAL, NEW-YORK FARMER, and MECHANICS' MAGAZINE, is removed to 132 *Nassau street*, opposite CLINTON HALL, and two doors *below Beekman street*.

☞ Will those Editors to whom the Journal is sent, do me the favor to notice this removal, send their papers in exchange, and request the friends of the Periodicals in the country to direct their orders to me at 132 Nassau street.

The favor shall be reciprocated at any and all times, by

D. K. MINOR.

March 23, 1836.

AERIAL NAVIGATION BY BIRDS.—A curious article on this subject appears in the December No. of the London Mechanics' Magazine. The writer is of the opinion that a sort of light wicker work may be drawn through the air by about 30 eagles. He thinks that young eagles might be trained in the same manner that poodle dogs and monkeys are in Naples—where he has seen them perform various amusing tricks.

We agree with him that to "realize a desideratum of this nature, it requires a person of property, who would devote his whole time (and money he might have said) to the pursuit; as the expense of purchasing and rearing up the eagles, together with able assistants, would be *considerable.*"

One method proposed for the guidance of this *team* is, by means of a long pole hung after the fashion of a rudder *before* the car; to the end of this, a piece of meat is to be fastened, and by varying the position of the pole the eagles are to be guided to one side or the other. Now setting aside this bird's aversion to any thing but *fresh* prey, we shudder when we think of the effect of a mental ejaculation of those eaglets equivalent to our "*sour grapes.*"

The writer himself thinks that "the subject in its childish state may appear to border on the ridiculous."

We do not mean to discourage any reasonable attempt to "navigate the air," but we do think it a fortunate circumstance that this gentleman is not a "man of property."

TRUE PATRIOTISM.—It appears from the Philadelphia National Gazette, that Bird Patterson, Esq., of Pottsville, Pa., has offered ONE THOUSAND DOLLARS A TON FOR TEN TONS OF GOOD IRON, SMELTED WITH ANTHRACITE COAL. This gentleman seems determined to go to work liberally, in bringing into play the resources of our country. It is the right way. We wish him success.

Extract of a letter, dated Hudson, April 5th.

Dear Sir,—As soon as spring opens fairly we shall have the whole line of our Railroad under contract. The whole distance from this to West Stockbridge is about 32 miles. The grading of the eastern half of the road is nearly complete; that of the western half is light, and will be finished before another winter, and by the middle of June, 1837, we expect to see our cars freighted with marble to beautify your metropolis. It appears now well understood that the Albany Road will intersect ours, and that half of our Road will be the joint stock of the Hudson, Albany, and Troy Companies. The Western Road from Boston will soon be built, and meet ours at Stockbridge. Passengers from New-York to Boston may then leave New-York in the evening boat, reach Hudson by daylight the next morning, take the morning cars for the east, and be in Boston at two o'clock, P. M.—do their business, and return the next day to New-York.

With great respect,

Yours, &c.,

J. W. F.

To the Editor of the Railroad Journal:

SIR,—In Vol. v., No. 7, of your valuable Journal, I find in the annual report of the Canal Commissioners to the Legislature of the State of New-York, on the subject of the *enlargement* of the Erie Canal, the following:—"With a view to the improvement of "the Erie Canal, the Commissioners have "divided the line into four sections," &c. * * "So far as the surveys made *last* "*season* [during only four months] have "developed the practicability of enlarging "the Erie Canal, and executing a perma-

"nent work, *without* MATERIALLY *interrupting the navigation*, nothing has appeared "insurmountable; * * it is, however, a "*difficult*, and, in some respects, *a fearful* "*undertaking*." To the candor of the Board, and the pen that drew these remarks, all praise is due: it is truly a "fearful undertaking;" and how far the city of New-York or the West can submit to any "material," or even *limited* curtailment of the navigation of the short period allowed us in this northern latitude, I leave you and your readers to determine. That *practical men* and engineers of the first order of talents are opposed to the project of an enlargement, and have fearlessly pronounced a *separate* and *distinct* work *better* and *cheaper*, is too public to be disputed. Engineers in the service of the State have also said that they were not called on for an opinion, or to estimate the cost of a separate and even parallel work to the Erie Canal from the Hudson to Buffalo; that such a work was more desirable for any engineer to undertake. It would certainly present less difficulties, and at probably not a greater expense than the enlargement, with the benefit of two separate and distinct canals, to provoke competition, and can be executed in much less time.

An appeal to the representatives of the people in relation to the enlargement of the Erie Canal, with the signature of *Oswego*, has been placed in my hands. I have read it with much interest. In the pen of the writer I think I can discover the comprehensive mind of a talented individual and old acquaintance, and I therefore extract a few remarks, to draw the attention of the public, and particularly the citizens of this State, *to the difficulties* which must present themselves to the most common eye, as to the *enlargement of the Erie Canal*, except at an expenditure *not to be justified*, and which would, beyond the shadow of doubt, furnish us with two canals to the "Far West;" and this, too, even without "*the aid*" of the General Government, to make the desired Ship Canal around Niagara Falls.

"The importance of making speedy and ample provision for the great and rapidly increasing trade between the East and the West, has for some time been apparent.—The means proposed for the accomplishment of this object have appeared to us inadequate and unsuited to the purpose. * * *

There is another very important consideration. The work must, most of it, be done at unfavorable seasons, and from the necessarily frequent interruptions, the cost must be much greater than would naturally be anticipated. In very many places the present channel must be abandoned, and an entirely new one constructed, and, as the work is to occupy a period of 12 or 15 years!! considerable allowance must be made for the increase in the mean time of the number of bridges, &c., rendered necessary by future improvements, and the greater amount of damage from the enhanced value of lands. To this must be added quadruple the usual allowance for the services of engineers, superintendence, &c., owing to *the extraordinary length of time required in making the enlargement*.

We are not alone in the preceding views. They are (and we speak not without knowledge,) *the disinterested opinions of three-fourths of the ablest Engineers in the country, men who are uncommitted on the subject.* * * * * * *

A most important item in the absolute cost of the enlargement remains to be considered. The benefit of the enlarged canal cannot be fully realized, until the improvement is effected throughout its whole extent. Neither the State or the public will therefore be materially benefitted by it until the expiration of the 12 or 15 years, when the work is to be completed. The interest, therefore, upon the one million of dollars, more or less, expended annually from year to year, for 12 or 15 years, must be estimated in the cost, and by uniting it with the other items above stated, and adding thereto the cost of the Erie Canal, which of course is merged in the enlargement, the total cost of the canal as enlarged, will not be rated by any rational, thinking man, at less than *twenty-seven millions of dollars*.

The question may now be asked, how are all these difficulties to be avoided? We answer, by opening an entire new channel from the Hudson to Lake Erie, by the way of Lake Ontario.

The total extent of artificial canal required on this route, if the course along the Mohawk valley—through Lake Oneida—the Oneida and Oswego Rivers be adopted, is only 150 miles, while by the Erie Canal it is 363 miles, making a difference of 213 miles of canal. Or if the route via Syracuse to Oswego be taken, as is not improbable, since it would present the advantages of a towing path the whole distance, and accommodate the Salt and Plaster trade, &c., a saving would still be made of nearly 170 miles of artificial canal.

The expense of opening a navigation on this latter route, having a depth of water not less than *eight feet*, with a width of surface of *ninety feet*, which is as small a width as should be allowed for that depth, will not, by the most liberal computation, exceed eleven millions of dollars, to wit:—$5\frac{1}{4}$ millions from the Hudson to Utica—$3\frac{3}{4}$ millions from Utica to Lake Ontario—and 2 millions from Lake Ontario to Lake Erie—around the Falls of Niagara.

This channel may be opened within five years from the period of its commencement. We shall, therefore, by adopting this course, obtain the benefit of a much larger navigation in about two thirds less time, at an expense not much exceeding the half of what it would cost to make the proposed enlargement from Albany to Buffalo. *The obstruction to the navigation so much dreaded will be avoided:* a better and more durable work will be obtained, as the masonry will be built, and embankments formed, under the most favorable circumstances; and when done, the State, instead of having but *one* Canal, at a cost of nearly 27 *millions* of dollars, *will have two Canals*, the combined cost of which will not vary much from 20 *millions*. The new Canal, if properly located, may be rendered much straighter than the present one, an object of importance, when it is considered that the boats which are to navigate it are to be of much larger dimensions, having treble or quadruble the tonnage of the present boats.

The number of the locks may likewise be very materially reduced by increasing their lifts. On the Erie Canal the average lift of the locks is about 8 feet. Should this average be increased to 12 feet, or thereabouts, as it may be with the greatest propriety, one third would be saved in the number of the locks. The expense for repairs and lock tenders, and cost of the locks, would thereby be lessened, and much time saved in passing them, which, to those engaged in navigation, would be deemed a very important consideration.

In exhibiting thus far the comparative merits of a separate channel, we have supposed that the Erie Canal would or could be *enlarged* to the size proposed according to the strict meaning of the term.

We do not hesitate to express the opinion that (setting aside the idea of a separate Canal,) *it would not be expedient to adhere to or enlarge the channel of the Erie Canal for a very considerable portion of the distance.* Independent of the bad location in many points of the present Canal, arising from the want of that experience in the construction of such works which our engineers have since obtained, *it is well known that a large Canal requires for its location entirely different ground from a small one.* This is necessary to its security and for other purposes. If the additional depth of water required to convert a four feet Canal into one of seven feet in depth, is obtained by raising the banks, the large body of water composing the Canal must be sustained at a greater elevation, compared with the natural surface of the ground; if, by depressing the bottom, there results an interference with the free passage of streams, and the drainage of the adjacent lands.

Independent of this difficulty, there are others in the case of the Erie Canal, which would render an enlargement of its channel in many places improper.

Those who are familiar with the ground on which it is located, and the section of country through which it passes, will readily perceive the propriety of this assertion.

From the Hudson to Schenectady, or some other point higher up the valley of the Mohawk, a new channel is demanded by the character of the intervening country, by which the crossing and recrossing of the Mohawk shall be avoided—the Canal straightened—and the distance materially lessened." HARLEM.

SLATE FLOORS.—The following notice from the London Penny Magazine, will probably be the means of introducing a new and valuable article for floors, for stores, factories, shops, &c., which possesses the advantage not only of durability, but also of *incombustibility*; and must therefore, we think, come into common use.

With a view of testing its advantages, an enterprising gentleman, who is an advocate for (not in the *common* acceptation of the term, but in *reality*) "fire proof buildings," has ordered several hundred tons of the article from England, to be laid in stores *now* erecting, and soon to be commenced by him.

SLATE.—Experiments have been made to ascertain the applicability of slate to other uses than the covering of houses. The result has been the discovery that, as a material for paving the floors of warehouses, cellars, wash-houses, barns, &c., where great strength and durability are required, it is far superior to any other known material. In the extensive warehouses of the London Docks it has been used on a large scale. The stones forming several of the old floors, having become broken and decayed, have been replaced with slate two inches thick; and one wooden floor, which

must otherwise have been relaid, has been cased with slate one inch thick; and the whole have been found to answer very completely. The trucks used in removing the heaviest weights are worked with fewer hands. The slabs being sawn, and cemented closely together, as they are laid down, unite so perfectly, that the molasses, oil, turpentine, or other commodity which is spilt upon the floor, is all saved; and, as slate is non-absorbent, it is so easily cleaned, and dries so soon, that a floor upon which sugar in a moist condition has been placed, may be made ready for the reception of the most delicate goods in a few hours. Wagons or carts containing four or five tons of goods, pass over truck-ways of two-inch slate without making the slightest impression. In no one instance has it been found that a floor made of sawn slate has given way; in point of durability, therefore, it may be considered superior to every other commodity applied to such uses. The consequences of this discovery have been, that full employment is found in the quarries which produce the best descriptions of slates, and that additional employment has been given to the British shipping engaged in the coasting trade.—[From a Correspondent.]

RAILROAD AND CANAL INTELLIGENCE.

MASSACHUSETTS.

The bill authorizing the Treasurer of the Commonwealth to subscribe *one million* of dollars to the WESTERN RAILROAD has passed one branch of the Legislature, by a vote so strong, as to leave no doubt as to its final success.

This Company has a charter for a road from Worcester to West Stockbridge,—forming a most important link in the chain of communication between Albany and Boston.

NEW-YORK.

A large meeting held at Delhi, has passed a series of resolutions, urging the immediate advancement of the Erie Railroad, and requesting the Senator of the district to vote for the bill.

MARYLAND.

The difficulties in the location of the *Baltimore and Port Deposite* Railroad have been removed at last by the Legislature. The question was, as to the right of the Company to select a certain route—contrary to the wishes, it appears, of the inhabitants. No suspension of the operations has taken place, and it is thought that the work will be completed sooner than was originally contemplated.

Maryland Internal Improvement Bill.—This bill, providing ten millions for the improvement in the State, has been referred to the next General Assembly, much to the sorrow of the good Baltimoreans.

PENNSYLVANIA.

The canal navigation has opened, with unusual spirit, it is said.

VIRGINIA.

Great rejoicing attended the opening of the Winchester road; the following is from the Republican:

☞ Our town begins to show the good effects of the railroad already. All seem to be on the look out for happier and finer prospects. Our depot presents quite a business appearance: goods for all quarters are daily arriving there, and any of our country friends who have idle wagons, would find plenty of employment, and ample remuneration, if they should be inclined to make a trip to Wheeling—$3 per hundred is now paid for transportation from Winchester to Wheeling.

So great was the accumulation of produce upon this road, that the motive power of the Company was found inadequate.

The Baltimore and Ohio Company very promptly sent them assistance in the shape of a locomotive.

SOUTH CAROLINA.

This State having appropriated $10,000 to the survey of the Cincinnati and Charleston Railroad, has also appointed Commissioners to advance the measure. It is understood that several of the United States Engineers have volunteered their services, and that the Secretary of War will suffer all such as can be spared to report themselves to the Commissioners for service.

The members of the Kentucky Legislature have held a meeting, and appointed delegates to the Convention at Knoxville, to be held next 4th of July.

MISSISSIPPI.

Jackson and Brandon Railroad.—Books were opened on the 2d instant, in Jackson and Brandon, for subscription of stock in this company. One thousand shares, of $100 each, were allotted to the people of Rankin county, which were taken before night on the first day. This really looks like "going ahead."

STEAM-PLOUGH.—At a meeting of the Grantham Agricultural Association, Mr. Hanley stated that he had seen a steam-plough at work in Lancashire, which did its work remarkably well, and turned up an acre of wet land, at a depth of nine inches, in 1 hour and 50 minutes.—[London Mechanics' Mag.]

CENTRIFUGAL FORCE.—At Little Green Logwood mill, Middleton, near Manchester, occupied by Mr. George Wolstencroft, there is a grindstone used for grinding the rasping knives for cutting logwood, upwards of 15 feet in circumference, and 11 inches and upwards thick. On the 24th ult, as Mr. John Wolstencroft, the son of the occupier, and another young man, were grinding the knives at the stone, the young man had screwed the machine in which the knife is held for grinding, rather too tight; this being observed by Mr. John, who also saw that the stone was revolving at a tremendous speed, he desired the young man to be cautious. No sooner had the words dropped from his lips, than the stone broke in several pieces, one of which, weighing not less than 6 or 7 cwt., forced its way through a wall a brick and a half thick, and drove a large quantity of the bricks upwards of 20 yards from the wall.—[A similar accident occurred some years ago. See vol. xviii. p. 32.]—[London Mechanics' Magazine.]

WILMINGTON AND RALEIGH (N. C.) RAILROAD.—We published, in our last, an account of the organization of this Company, and intended to have called the attention of our readers to the subject.

We republish it at the request of a friend, and are gratified to be able to learn that they have engaged Walter Gwynn, Esq., as Chief Engineer, and that it is the intention of the Company to prosecute the work with energy.

WILMINGTON AND RALEIGH RAILROAD.

Meeting of Stockholders.

Pursuant to public notice, the Stockholders in the Wilmington and Raleigh Railroad, met at the Court House in Wilmington, N. C., on the 14th March, 1836, and were organized by the appointment of Wm. D. Mosely, Esq., as Chairman, and Gen. James Owen as Secretary.

After the objects of the meeting were explained, the following proceedings took place.

On motion, Resolved, That Gen. E. B. Dudley, Gen. Alex'r Mac Rae, and James S. Green, Esq., be a committee to examine such proxies as may be presented. This committee reported that 1296 shares are represented by proxy * and 3360 by individual stockholders.

Resolved, That the salary of the President of this Company be fixed at $2000 per annum.

Resolved, That the offices of Secretary and Treasurer be filled by the same person, during the present year, at a salary of $1000 per annum.

Mr. Lazarus, Chairman of the Commissioners, submitted their report, which was accepted.

The meeting proceeded to elect a President and ten Directors. A ballot being had, Gen. E. B. Dudley was elected President, and Andrew Joyner, W. D. Mosely, James S. Battle, A. Lazarus, A. Anderson, Wm. B. Meares, P. K. Dickinson, James Owen, R. H. Cowan, and Thomas H. Wright, Directors.

Whereas, subscriptions to the capital stock of this road have been made along the contemplated route, as well as at Wilmington—therefore,

Resolved, That the President and Directors be authorised to have the road commenced both at Wilmington and Halifax, due regard being had to the amount subscribed north and south of Contentnea creek; and that the President and Directors be instructed to commence the work with as little delay as possible.

Resolved, That the President and Directors be hereby directed to cause the road to be located on the most eligible route from this place to Halifax.

Resolved, That a general meeting of the stockholders shall be held in this place on the first Monday in November next, and thereafter, annually, on the first Monday in May.

Adjourned to 10 o'clock to-morrow.

TUESDAY, March 15.

Stockholders met at the Town Hall.

Resolved, That the President and Directors be authorised to re-open the books of subscription, at such times and places as

* The proxies were, Hon. Wm. D. Mosely, representing the Lenoir stock; Robert Soutter, Esq., the Norfolk do.; Gen. Blount, of Nashville, the Nash and Edgecombe do.; Dr. Andrews and Mr. Lane, of Waynesboro', the Wayne do.; and Gen. Alex'r Mac Rae, the Edgecombe do.

they may deem expedient, and under the superintendence of Commissioners, to be appointed by them, for an amount of stock not exceeding 2,000 shares.

Resolved, That a Committee of three be appointed by the Chair, to draft and present, for the consideration of the Stockholders, at their next general meeting, a code of Bye-Laws for the regulation and government of the Company.

Whereupon, W. B. Meares, A. Lazarus, and A. Anderson, were appointed said Committee.

On motion of Gen. Blount,

Resolved, That the Engineer be instructed to examine a route touching at or near the town of Waynesborough, on Neuse River, and thence at or near Rocky Mount, the great Falls of Tar River, and report thereon to the President and Directors—[this resolution amended on motion of Gen. A. Mac Rae]—and also by Duplin Coarthouse, Rockford on Neuse, and Tarborough, and such other routes as may be suggested or approved by the President and Directors.

Resolved, That the thanks of the Stockholders be tendered to the Chairman of the Commissioners, and the Chairman and Secretary of this meeting, for the zealous and able discharge of their respective duties.

The meeting adjourned, to meet in this place on the first Monday in November next.

W. D. MOSELY, Chairman.

JAMES OWEN, Secretary.

Immediately after the adjournment of the meeting of Stockholders, the Directors met, and appointed Gen. ALEXANDER MAC RAE Superintendent of the Railroad, and JAMES S. GREEN, Esq., as Secretary and Treasurer. They also instructed their President to engage the services of WALTER GWYNN, Esq., as their Principal Engineer; and in pursuance of authority given by the Stockholders, have determined forthwith to re-open books of subscription for an amount not exceeding 2,000 shares.

The services of Major GWYNN have been engaged, and the survey will be commenced immediately.

COPY OF A LETTER FROM BENJAMIN CHAMBERLAIN, FIRST JUDGE OF CATTARAUGUS COUNTY, TO THE HON. E. MACK, CHAIRMAN OF THE RAILROAD COMMITTEE OF THE SENATE OF NEW-YORK.

Albany, March 16, 1836.

Dear Sir,—In compliance with your request, that I should state the facts within my knowledge, relative to the navigation of the Alleghany river, and the lumber products in its vicinity, I beg leave to inform you that I removed into the present county of Cattaraugus, about twenty eight years ago, being at that time seventeen years of age, where I have ever since resided, and during the whole of the time within three miles of the river in question. My business has been that of rafting lumber down that stream, which I have descended every year during that period, at least once a year — and in some years four or five times.

From the knowledge thus acquired, I am enabled to state, that the navigation of the river always remains open in the fall until late in December, and frequently into January. It was not closed the present year until after the 20th of the latter month. In the spring it is also most invariably clear of ice by the 1st of March, and sometimes earlier; and I never knew it to be later than the 10th of March. I was on its banks on the fifth day of the present month, and the ice then was out of the river, and the navigation open and uninterrupted.

The stream, leading into the Ohio, forms the only direct communication between this State and the valley of the Mississippi; and several years ago, it used to form one of the principal channels through which the emigration to the far west was conducted. Emigrants were in the habit, until diverted by the opening of the Erie canal and by other channels through Pennsylvania, of embarking at Olean, in our county, and I have known from four to five hundred arks to leave that place in a single season. An ark built water tight, and securely covered, so as to carry fifty tons of merchandise, can be built for fifty-five dollars. Its draft of water will not exceed 16 inches, and there is hardly any season of the year in which there is not that depth of water in the river, all the way from Olean to Pittsburg. In order to raft lumber to advantage, a greater depth of water, say from two to three feet, is requisite; and this will explain why the running of lumber in rafts is frequently delayed for a week or a fortnight after the river is clear of ice in the spring, and sufficiently deep for arks carrying merchandise. I have never during the last twenty-eight years, known the river to fail to be navigable during the month of March, both for arks and rafts. The channel of the river is free from rocks or other obstructions. The bed of the stream consists of gravel or rounded pebbles, rendering its descending navigation usually secure, and much superior in that respect to the Susquehannah, and even to the Ohio itself below Pittsburg.

The width of the river at Olean is about 20 rods; at the State line, betwen 30 and 40 rods; at Warren, (18 miles below the State line, and where it receives an important branch from the outlet of the Chautauque lake,) between 40 and 50 rods; and at Pittsburg, upwards of 100 rods. At an average state of the water, the current flows at the rate of 5 miles an hour, but at its low stages, not more than 3 and an half. From the State line to Pittsburg, the distance by the river is 192 miles, and from Olean 42 miles further. In a fair state of water, arks can be run from Olean to Pittsburg in less than three days, and in any stage when the river is navigable, in 5 days. The ark is worth, at Pittsburg, as much as it costs at Olean, and if desired, it could continue down the Ohio with its load of merchandise, to Cincinnati or Louisville. It would reach Cincinnati from Pittsburg, in the spring, in 5 or 6 days. The expense of running merchandise on arks as above mentioned, from Olean to Pittsburg, will not exceed 15 cents, and probably not over 12½ cents per 100 pounds.

Steamboats have occasionally ascended the river as far as Warren, and upon one occasion as high as Olean.

In respect to the price of lumber lands in the vicinity of the river, I have to state that the average quantity produced upon them will not vary much from 15,000 feet of boards to the acre; though I have known a single acre to yield from 50 to 70,000 feet. There cannot be less than 500,000 acres of land thus covered within 30 miles of the route of the New-York and Erie Railroad. Of this lumber an unusual proportion is of fine quality. From my personal knowledge of the quantities sawed at the different mills in the vicinity, I estimate the amount annually exported down the river to be from 150 to 200,000 feet. Of that amount at least one fifth is what is termed "*pannel stuff*," worth at Olean, in average years, $7 per thousand; at Cincinnati, from 12 to 14 dollars, and in the city of New-York (as I am informed) from 28 to 36 dollars per thousand. The streams of our county afford hydraulic power sufficient to manufacture more than double the amount of lumber now sent to market.

In conclusion I beg leave to add, that very little, indeed scarcely any, of the lands of Cattaraugus or Alleghany counties can properly be denominated *waste land*. Although our inhabitants have been principally engaged in the manufacture and export of lumber, the soil of a great part of their lands is capable, with proper cultivation, of producing good wheat, and it presents capabilities for grazing not surpassed by any part of the State. We are, nevertheless, laboring under great disadvantages for want of the means of cheap transportation. The waggoning of our salt and plaster, which we are compelled to draw from Buffalo and Batavia, distances of 60 and 70 miles, costs as much as the salt and plaster themselves, and yet you will perceive that the population of our county, which in 1825 amounted to only 8,643 inhabitants, had increased in 1830 to 16,726, and, according to the census of 1835, just returned, has reached to 24,986.

I am respectfully yours,

B. CHAMBERLAIN.

Hon. EBENEZER MACK, Ch'n Railroad Committee of the Senate of New-York.

REPORT OF THE CANAL BOARD, UNDER THE ACT PASSED MAY 11, 1835, IN RELATION TO THE ENLARGEMENT OF THE ERIE CANAL.

Continued from our last.

The necessity of adding to the capacity of the Erie Canal, has for several years been apparent; and so forcibly was this matter impressed on the Legislature of 1834, that an act was passed authorizing the construction of an additional set of lift locks from Albany to Syracuse.

An additional set of locks would increase the capacity of the Erie Canal about 80 per cent., and might prolong the absolute necessity of enlarging the Canal a few years. But when the circumstances under which the enlargement must be made are properly considered, it will readily be seen that several years must necessarily be occupied in the execution of the work. Hitherto the business on the Canal has exceeded the public expectation. If we take into view the unparalleled fertility and increasing productiveness of that immense country, the commercial intercourse of which with the Atlantic must be carried on by the Erie Canal, it is not difficult to imagine a constant and rapid augmentation of business, and it is more than probable that the improvement in question will be required as soon as its execution can be accomplished on the present plan of operations.

Another important consideration which is entitled to great weight, in determining the question of time, within which the im-

provement of the Canal should take place, is, that a large Canal is not only desirable and beneficial, in reference to the amount of tonnage which may be carried upon it, but because it materially lessens the expense of transportation. This circumstance exerts an important influence in increasing the amount of tonnage on a Canal. It creates an accession of business, and consequently enlarges its usefulness to the country through which it passes, in the transportation of coarser and cheaper articles, and extends the business in a relative proportion over a larger district.

The enlargement of the Canal and locks to the proposed dimensions will lessen the expense of transportation, exclusive of toll, about 50 per cent. This difference applied to the business of the past year, assuming the aggregate expense of transportation to be 20 per cent. greater than the gross amount of tolls, (which is believed to be a low estimate,) would be a saving of $826,007 81, and in ten years, calculating the same rate of increase to the tolls that has taken place in the past ten years, it would amount to $12,793,221 30.

The enlargement of the Canal is intimately and necessarily connected with the utility of a double set of lift locks, and hence the propriety of commencing the work as soon soon as practicable, and of prosecuting it with as much diligence as the funds appropriated to this object will admit.

The funds at the disposal of the Canal Commissioners for the purposes of the law under which they are now acting, will be too limited to justify a commencement of the work on every part of the line, and as speedy a prosecution to its completion as an unlimited appropriation would admit. It is therefore deemed advisable to confine the operations to the line between Albany and Syracuse, until such time as the funds will justify a beginning on the other parts of it, without interfering with the speedy completion of the work on the line above referred to.

This arrangement will render available the advantages of the enlarged Canal before the whole is completed, as it would no doubt be a saving in the expense of transportation to tranship the cargo in most cases from the small to the large boats.

The proposed width of lock will permit the convenient passage of boats 17 feet wide, and a little exceeds the transverse ratio of boat and Canal most favorable to the power of traction, but is about six feet narrower than would correspond with the proportion which the present locks bear to the Canal.

It is stated that the locks on the present Canal to conform to the rules governing the "economy of traction," should be a little less than 10 feet wide, and the cargo but 32 tons; whereas, 45 or 50 are sometimes to be advised on the score of economy.

It should, however, be borne in mind, that on a Canal as large as the one proposed, where the business is such as to require the frequent meeting and passing of boats, and sometimes three abreast, there is a much greater necessity of restricting the width of boats to proper limits than now exists on the Erie Canal. It is quite apparent that the boats are now too wide for the present Canal. Boats are constantly coming in contact with each other, or are driven against the towing-path by the passing boat. Much injury to boats, and some interruptions to the navigation, are occasioned by this circumstance. This difficulty should be obviated on the enlarged Canal, as the injury would be more extensive by reason of the greater magnitude and weight of the boats.

At a meeting of the Canal Board on the 23d of November last, the Canal Commissioners submitted the report of Nathan S. Roberts, John B. Jervis, and Holmes Hutchinson, who had made the necessary examinations in reference to the most favorable location for a new aqueduct over the Genesee river at Rochester, and also for a suitable location for a new weigh-lock. Their report is herewith submitted.

In the fall of 1834, the Canal Commissioners had adopted a plan for constructing a new aqueduct on the present location, by turning new arches under the old ones, and extending them a sufficient distance above and below the present aqueduct, to obtain 36 feet of water-way and new parapet walls. The aqueduct was designed for five feet depth of water.

With the proposed enlargement of the Canal, the present location of the aqueduct in several respects would be objectionable. The short curve in the Canal at the east end of the aqueduct, renders the passage of boats inconvenient. This objection would be much more formidable for large boats. The width of the water-way in the aqueduct could not be increased without material injury to the extensive flouring mills of Harvy Ely, on the east side of the river, of Thomas Kempshall, on the west side, and the removal of the flouring mill lately owned by Benjamin Campbell, on the south side of the aqueduct.

By referring to the report of the Engineers, it will be seen that lines for two locations have been surveyed: the one commences 200 feet, and the other 300 feet above the present aqueduct, on the east side of the river, and both connect with the Erie Cenal at the same point en Exchange-street, on the west side of the river. The first line above the aqueduct has been adopted. On this location the curve in the Canal at the east end of the acqueduct will be much improved. An entire new work will be constructed, better in its appearance, and probably more permanent than the work contemplated on the present location The width of the water-way will be increased to 45 feet, and the new line admits of the location of a weigh-lock parallel with the Canal, and a collector's and inspector's office adjoining it on the west side of the river.

The present location of the nine locks above the junction, has not left sufficient pound reaches between them for the convenience of navigation. To lengthen and double these locks, will increase this inconvenience. To obviate this objection, the Canal Commissioners directed a survey, for the purpose of ascertaining the practicability and expense of changing the presnet line. The survey shows that a new line may be located, commencing below the junction, and connecting again with the present line a short distance above the Nine Locks. By this location, the lifts are differently arranged, and one lock is dispensed with. On this line, the work could be performed without interfering with the present line.

The surveys which have been made indicate that several important deviations may be made from the present line of the Erie Canal, to wit: a continuation of the new line, which has been mentioned, diverging from the present line below the junction, to the head of the four locks above the Cohoes Falls, and from thence, on the south side of the Mohawk River, to its intersection with the present line above the upper aqueduct; from four miles above to one mile below the Schoharie Creek; a new line passing through the village of Rome; an extension of the Geddes level to the level west of the village of Jordan, by which the Jordan summit would be avoided; a new line from the lock west of Port Byron to Montezuma, with a view of taking a feeder from the Owasco Creek, below the flouring mill of Beach & Co.; and a new line east of Rochester, in order to avoid a great bend in the Canal at Brighton.

The examinations which have been made are not sufficiently matured to enable the Canal Board to determine the question affecting the alterations; but they may result in the opinion that the public interest requires them to be made. If so, the alterations on the eastern section must be made next season, in order that the new locks may be put under contract. It will be seen that if these alterations are made, a new Canal, on the enlarged plan, must be constructed simultaneously with the locks.

In connexion with the changes which are indispensable to the enlargement of the Erie Canal, according to the proposed plan, the Canal Board are deeply impressed with the importance of making such other improvements essential to its usefulness, as shall be commensurate with the means and interest of the State, and the character of the most important artificial communication in the world.

The Canal Board, however, duly appreciate the propriety of making no deviations from the present line, that are not clearly sanctioned by considerations of public utility. Investments and various improvements have no doubt been made on many parts of the present line, under the expectation of its continuance; and although this circumstance should not be permitted to operate against the interest of the public, it is entitled to a respectful consideration.

Dated, Albany, January 23d, 1836.

S. Van Rensselaer,
Wm. C. Bouck,
Jonas Earll, Junior,
John Bowman,
John Tracy,
A. C. Flagg,
John A. Dix,
A. Keyser,
William Campbell.

From the London Mechanics' Magazine.

EVIDENCE OF DR. LARDNER

On the Great Western Railway Bill.

3d of August, 1835.

(Continued from page 59.)

[The witness is referred to two sections on the table.]

Were these prepared by you?—Yes. I was asked whether the summit level of the line had any necessary connexion with the power necessary to work it, and I drew these specimens to show that there might be two lines, one of which has a very high summit, and the other a very low one, and yet which require the same total power to work them.

Just produce them, and explain them?—If you suppose this section, No. 1, to represent two roads, one of them consisting of one continuous slope rising 1 in 300, and then one descending slope of 1 in 300, and then another, with the same termini, consisting of six short ascending slopes of 1 in 300 interrupted by six descending slopes of 1 in 300,—I take 1 in 300 as an example merely,—the power necessary to work these would be precisely the same.

According to the plan you now hold in your hand, though the lower line, the darker line, attains so much lower a summit level than the lighter line, the same power is required to surmount the one as the other?—Yes; the one is a succession of summits, and the other one only; and to compare these it would be necessary to bring all the ascending slopes to one end, and all the descending to the other, and on comparing you would then find them the same.

Does not it follow, then, as an inevitable conclusion, that the mere summit level of two sections does not of itself afford any thing like a conclusive estimate of the power necessary to surmount that summit level?—Certainly not.

A plan which shall show two summit levels, one twice as high as the others, may not give any thing like a fair estimate of the power required to surmount the two?—You must not judge by the summit level—very little depends upon that.

Is it not obvious that a much higher summit level may be obtained by less power than a lower summit level, if, in attaining the lower summit level, you have more objectionable inclinations?—Yes, every thing depends upon the graduation.

So that if power be lost on the lower more than the higher summit level, the mere surface would be calculated much to mislead?—It would not mislead scientific men or engineers.

But to mislead a common spectator?—Yes, people not acquainted with the subject.

In the section you have exhibited, No. 1, you say the same power would be required for the two lines?—Yes.

You have another marked 2?—Yes; in which the lower would require the greater power.

That is, the lower and darker section would require a higher power than the upper?—Yes; the slopes are more steep.

Yet they both start at the same point?—Yes; and one is a higher summit level than the other.

And the sum of the ascents upon the undulating line on the last plan are greater than the sum of the ascents on the other?—That is not necessarily a test.

Is it not the case with this section?—It may be so; I have not measured it; that is not the test.

Explain how it is that less power is required to attain the higher summit?—If you add together all the perpendicular heights that the load has to be lifted in ascending, and then subduct from it all that falls upon an acclivity which is not more steep than 1 in 250, you will then get a number of perpendicular feet which the power is to overcome; but, in addition to that, it will be necessary to take those descending slopes which are more steep than 1 in 250, and allow for them as giving back so much power as they would give back if they were only 1 in 250, and then you get the number of perpendicular feet that the power is to overcome. The loss arising from steep slopes consists in this, that any descending plane more steep than 1 in 250, will only give back as much power as it would give back if it was 1 in 250; the consequence is, there is a number of perpendicular feet lost wherever there is a steeper incline than 1 in 250.

One in 250 is the point of rest?—That is the angle of repose.

Witness handed in the following paper:—

"*Calculation of the Amount of Mechanical Power necessary to draw a Ton from London to Bath, and from Bath to London, on the Great Western and Basing Lines, the Power being expressed in the equivalent Number of Pounds raised Three Feet high.*

"GREAT WESTERN RAILWAY.

"*London to Bath.*

	Feet.
Sum of all the rises	383
Sum of all the falls, not exceeding 1 in 250	243
	140
Fall at Box-hill, estimated at 1 in 250	51·98
To be overcome by power	83·02

	Yards.
Distance from London to Bath	192,588
Friction at 9lbs. per ton in pounds raised 1 y'd	1,733,292
Power to raise 1 ton 88·02 feet	65,722
Resistance from London to Bath in pds. raised 1 yard	1,799,014

"*Bath to London.*

	Feet.
Sum of all the rises	364·5
Sum of all the falls, not exceeding 1 in 250	337
	27·5
Effective fall of Euston-square incline	15·91
	11·59

	Yards.
Friction at 9 lbs. per ton in pounds raised 1 y'd	1,733,292
Power to raise 1 ton 11·59 feet	8,654
Total resistance from Bath to London in pounds raised 1 yard	1,741,946

"BASING LINE—*London to Bath.*

	Feet.
Sum of all the rises	480
Sum of all the falls, not exceeding 1 in 250	181
	299
Effective fall of slope 1 in 202	141·6
To be overcome by power	157·4

	Yards.
Distance from London to Bath in yards	187,396
Friction at 9lbs. per ton in pounds raised 1 y'd	1,686,564
Power to raise 1 ton 157·4 feet	117,525
Total resistance from London to Bath in pounds raised 1 yard	1,804,089

"*Bath to London.*

	Feet.
Sum of the rises	355
Sum of the falls	480
Total effective fall	125

	Yards.
Friction at 9 lbs. per ton in pounds raised 1 yard high	1,686,564
Effective aid derived from fall of 125 feet	93,333
Total resistance from London to Bath in pounds raised 1 yard	1,593,231

Mr. Talbot.—Is that taking all the slopes upon our line?—Yes; including Euston-square and the Box-plane.

Mr. Joy.—If it has been stated in evidence by Mr. Locke, that there are fewer accidents on the descending slope upon the Manchester and Liverpool Railway than upon other parts of the line, would not that answer—I do not mean intentionally—be fallacious in this respect, that the length of the line is about thirty-one miles, whereas the length of the incline is only about a mile and a half?—The fact that there are more accidents on that slope than on any other portion of the line of equal length, is notorious.

You cannot fairly compare that plane with the whole line?—You cannot compare that one mile and a half with the twenty-eight miles.

Mr. Joy.—Have you some other tables marked 4, 5, 6, and 7, which you have prepared?—Yes; I wished to verify the result of the calculation, as it would be satisfactory to make them prove themselves, by making a calculation of the same thing, by two different processes and formularies, so that it should be seen, that it was not only arithmetically right, but right upon principle; and I have proceeded to obtain the total mechanical power necessary to work the lines by both methods; the results coincide so nearly as to perfectly verify each other.

[The witness delivered in the tables referred to.]

Are these tables illustrative of the speed?—These tables include the speed which the road would be traversed with, subject to two different conditions; one, that the maximum speed is limited to thirty miles, and the other to forty miles an hour: they also state the length of line in yards, and the mechanical power necessary to overcome every slope.

On each line?—Yes, expressed in pounds weight raised a yard high; they also express the resistance in pounds per ton every slope, from one end to the other.

Backwards and forwards?—Yes.

What are the termini?—Euston-square and Bath.

Not Bristol in either case?—No.

Mr. Joy.—Taking the speed in the first instance, as not exceeding thirty miles an hour for the maximum, what time would be consumed upon the Great Western from

London to Bath?—From London to Bath on the Great Western would take, on that supposition of thirty miles an hour, four hours fifty-five minutes twenty-three seconds; on the Basing line, four hours fifty-nine minutes and fifty-seven seconds; and from Bath to London on the Great Western it would take four hours fifty-four minutes forty-four seconds, and on the Basing line four hours forty-three minutes forty seconds; and then both ways, backwards and forwards, on the Great Western it would take nine hours fifty minutes and seven seconds, and on the Basing, both ways, nine hours forty-three minutes and thirty-seven seconds; the difference in favor of the Basing line, six minutes and thirty seconds. This is on the supposition that the plane is 1 in 202.

Have you got the difference, if it was calculated at 1 in 250?—No, I have not.

With a speed not exceeding forty miles from London to Bath?—Four hours forty-four minutes and forty-four seconds on the Great Western, and on the Basing four hours forty-nine minutes and forty-seven seconds.

Bath to London?—Four hours forty minutes and twenty-one seconds.

Basing?—Four hours twenty-eight minutes and thirty-six seconds.

London to Bath and Bath to London, the Great Western?—Nine hours twenty-five minutes and five seconds; and on the Basing, nine hours eighteen minutes and twenty-three seconds; the difference in favor of the Basing, six minutes and forty-two seconds.

What rate do you assume on the level?—Twenty-five miles an hour.

Is that for the forty?—For both.

Have you got any other tables?—Yes.

Do they relate to another point of your examination?—A comparative view of the two lines with respect to their average power and their greatest resistance: the results are here brought together.

The results of the other tables are brought together?—Yes.

The witness delivers in the following papers:—

Comparative View of the Great Western and Basing Lines.

	G. Western.	Basing.
Total mechanical power necessary to work the line both ways, calculated by estimating the resistance upon each successive slope from the table of gradients, expressed in pounds weight, lifted three feet high -	3,540,965	3,397,316
Difference of total mechanical power in favor of the Basing line - - - -	......	143,649
Total mechanical power necessary to work the line both ways, calculated by allowing nine pounds per ton for friction throughout the whole distance, and then estimating the power necessary to lift the load through the sum of all the rises, and the quantity of this power restored by the sum of all the falls -	3,540,960	3,397,320
Difference in favor of the Basing line - - - - - -	......	143,640
Total length of the line in yards	192,588	187,4[illegible]6
Difference in favor of the Basing line - - - - - -	......	5,192
Average resistance of the line, worked both ways, in pounds per ton - - - - - - - -	9·1879	9·0645
Difference in favor of the Basing line - - - - - -	......	0·1234
Maximum resistance on ascending slopes from London to Bath in pounds per ton - - - - -	35·05	17·96
Difference in favor of the Basing line - - - - - -	......	17·09
Maximum resistance on ascending slopes from Bath to London in pounds per ton - - - - -	29·93	20·09
Difference in favor of the Basing line - - - - - -	......	9·84
Time of transit from London to Bath and from Bath to London, thirty miles an hour being taken as the greatest allowable speed - - - - - - - - - -	h. m. s. 9 50 7	h. m. s. 9 43 37
Difference in favor of the Basing line - - - - - -	......	0 6 30
Time of transit from London to Bath and from Bath to London, forty miles an hour being taken as the greatest allowable speed	9 30 5	9 18 23
Difference in favor of the Basing line - - - - - -	......	0 11 42
Length of an absolutely level line requiring the same quantity of mechanical power - - - -	Yards. 196,721	Yards. 188,739
Difference in favor of the Basing line - - - -	......	7,982
Effect of the gradients expressed in equivalent increase of length	4,133	1,343
Difference in favor of the Basing graduation - -	......	2,790
Comparative amount to which the power necessary to work the line both ways would be reduced if the Box-hill and Euston-square planes on the Great Western were converted into absolute levels, expressed in pounds raised one yard - -	3,466,586	3,397,318
Difference in favor of the Basing line - - - - - -	......	69,268
Greatest resistance from London to Bath, exclusive of Euston-square slope, in pounds per ton	16·27	17·95
Greatest resistance from Bath to London, exclusive of the Box-hill slope, in pounds per ton -	15·53	20·06

Since the preceding calculations were made, it has been proposed to reduce the gradient of 1 in 202 on the Basing line to 1 in 250. This will alter several parts of the comparative estimate of the two lines. In the following table I have made these changes:—

Comparative View of the Great Western and Basing Lines, the Gradient of 1 in 202 being supposed to be changed to 1 in 250.

	G. Western.	Basing.
Total mechanical power necessary to work the line both ways	3,540,965	3,373,128
Difference of total mechanical power in favor of the Basing line - -	......	167,832
Total length of the line, in yards	192,588	187,396
Difference in favor of he Basing line - - - -	......	5,192
Average resistance of the line, worked both ways, in pounds per ton - - - - - - - - -	9·1879	9.0000
Difference in favor of the Basing line - - - - -	......	0·1879
Maximum resistance on ascending slopes from London to Bath, in pounds per ton - - - - -	35·05	17·96
Difference in favor of the Basing line - - - -	......	17 09
Maximum resistance on ascending slopes from Bath to London, in pounds per ton - - -	29·93	17·96
Difference in favor of the Basing line - - - -	......	11·97
Time of transit from London to Bath and from Bath to London, thirty miles an hour being taken as the greatest allowable speed - - - - - - - - - -	h. m. s. 9 50 7	h. m. s. 9 43 37
Difference in favor of the Basing line - - - -	......	0 6 30
Time of transit from London to Bath and from Bath to London, forty miles an hour being taken as the greatest allowable speed -	9 30 5	9 18 23
Difference in favor of the Basing line	......	0 11 42
Length of an absolutely level line requiring the same quantity of mechanical power - -	Yards. 196,721	Yards. 187,396
Difference in favor of the Basing line - - - - -	......	9,325
Effect of the gradients expressed in equivalent increase of length	4,133	—
Difference in favor of the Basing graduation - -		4,133
Comparative amount to which the power necessary to work the lines both ways would be reduced if the Box-hill and Euston-square planes on the Great Western were converted into absolute levels, expressed in pounds raised 1 yard - -	3,466,596	3,373,128
Difference in favor of the Basing line - - - -	......	93,453
Greatest resistance from London to Bath, exclusive of Euston-square slope, in pounds per ton	16·27	17·95
Greatest resistance from Bath to London, exclusive of the Box-hill slope, in pounds per ton -	15·53	17·35
Average resistance from London to Bath and from Bath to London, the Box-hill and Euston-square slopes being supposed to be reduced to levels, in pounds per ton - - - - -	9	9

Have you calculated the length of a line absolutely level which would be mechanically equivalent to each of the proposed lines?—I have.

What is the difference in favor of the Basing line?—The length of a line absolutely level, requiring the same mechanical power as the Great Western Line, would be 196,721 yards; and the length of a line absolutely level, equivalent mechanically to the Basing line, would be 188,739 yards. This is on the supposition that the greatest slope on the Basing line is 1 in 202, and in that case the difference would be 7,982 yards in favor of the Basing line.

Have you calculated what is the average power of traction per ton required upon each of the two lines?—Yes, I have. The average resistance of the line worked both ways expressed in pounds per ton for the Great Western is 9.1879, and for the Basing 9.0645; that is, in more popular language, it would be 9 lbs. and 19-100ths for the Great Western, and 9 lbs. 6-100ths for the Basing; that is supposing the slope to be 1 in 202, and taking into account the Euston-square slope, and the Box-hill slope, taking into account the whole line and every thing on it.

Will you have the goodness to tell me if you have made any calculation of what force must be applied to the break in order to prevent an increase of speed down the Box-hill slope?—The resistance that the break must exercise to oppose the descent of the load down the slope I stated to be 12 lbs. per ton; then, in order to produce that, the break must be pressed upon the tire of the wheel with such a force as to give that resistance, namely, 12 lbs. per ton. Now the pressure of the break upon the wheel would require to be from five to six times the amount of the resistance required, because the proportion that the actual pressure of the break bears to the resistance, supposing it to be made of such a wood as elm, will be five or six times, so that, if we want to produce a resistance of 12 lbs. a ton, we must press the break upon the wheel with a force amounting to 60 or 70 lbs. a ton.

This is assuming the friction necessary to retard going down the Box-hill?—Yes.

Now give me the same answer with reference to the descent at Euston-square?—That is 1 in 86, I believe. The force down a plane of 1 in 86 would be 17 lbs. per ton, and 5 times 17 are from 85 to 90 lbs.; that would be the pressure necessary to counteract the whole resistance.

What means have you taken to verify the calculations you have made respecting the mechanical power and other matter to be satisfied of their accuracy?—In my calculations I have proceeded by two totally different processes and formularies. In the one case I have considered the resistance that the power has to overcome from one end of the line to the other by the friction; this is 9 lbs. per ton; the total effect of that is a matter of easy calculation. I then consider separately the effect of all the rises and all the falls. In every rise the moving power must lift the whole weight of the train through the number of perpendicular feet in the rise; in every fall less steep than 1 in 250 a quantity of power is got back equal to the number of perpendicular feet in the rise; in every fall more steep than 1 in 250 the quantity of power is got back equal to the number of perpendicular feet which would be found if the fall was only 1 in 250. Having computed these, I then combine them with the result of friction; the latter is 9 lbs. per ton. I add them or subtract them, according as gravity assists or opposes the friction, and the result is the total mechanical power acquired to transfer the load from one end to the other, and I do this in both directions, and add the results, and get the total power both the one way and the other; that is one way of calculating. Then I made the same investigation by another totally distinct method; in this case I took all the slopes from one end of the line to the other. I take the common method of expressing the resistance to the drawing power on each slope expressed in pounds weight per ton; from that resistance and the length of the slope I obtain by a simple arithmetical process the total power required to draw a load from one end to the other of the slope. Having done this for all the slopes from one end to the other of the line, I added the results together, and obtained the total mechanical power in both directions. Now, upon comparing the results of those two methods of calculation, you can see how nearly they coincide.

Do you find them nearly coincide?—From Bath to London there is no difference in the calculations: they agree to the last unit. On the Great Western, and from London to Bath, there is a difference of 5 lbs. in rather less than 2,000,000 lbs.; and on the Basing line, from Bath to London, a difference of 1 lb.

Can you at all account for that slight difference?—Yes; it arises, most probably from a few decimal places being neglected in the one case that were taken in the other.

In the calculation you made, have you or not included the slope of 1 in 86, the Euston-square slope, and 1 in 107 at Box-hill?—I have included the power absolutely expended in working the slopes, but I have not made any allowance for the waste of power which must be incurred in whatever way these slopes are worked. If it is worked by a single rope, I have not included the power necessary to pull the rope back, or to work the rope, but the bare power necessary to draw the load on the slope.

How does it happen that the Great Western line has the effect of an ascent in both directions?—That is a very common consequence of graduation. The line at the one end may be a number of perpendicular feet below the other end, and the graduation may be such that it may have the effect of an up-hill both ways, as is the case on the Great Western; that arises from the two steep inclines. In going down those steep inclines we do not get back the power that is expended in ascending, and they do not give it back for the reason I have already stated; they can only give it back at the rate of 1 in 250. Now the acclivities are both considerably greater than this, and consequently a number of perpendicular feet of fall are lost.

Mr. Talbot.—Allow me to call your attention to this question; you have stated that in the case of the tunnel there would be so much greater power required, and that power requiring a greater proportionate quantity of combustion, that the ill effects would be produced in that proportion?—Yes, on a given quantity of air.

You did not add that. To a question, what would be the proportion of increase in the consumption of fuel, you say, as thirty to nine. "In the same proportion as the increase of power?" "Yes; I may assume that the destruction of vital air and the production of noxious air is in the proportion to the mechanical power exerted?"—Yes.

And only that?—Only that.

Then the consumption of power up the Box tunnel is as thirty to nine?—Yes; there are 30 lbs. of power to 9 lbs. on a level.

What is it the other way?—What do you mean?

Descending?—Nothing at all; there is no power used in descending.

If there be no power at all that way, may I not say that, taking it both ways upon two trips in this tunnel, I have an average of fifteen to nine?—If you put it in that way.

Is that an unfair mode of viewing it?—That depends upon the object you have in view in putting it so. The fact is, you consume no fuel in going one way, and you consume it in the proportion of thirty to nine in the other.

And this tunnel being to be used both ways, it is not fair to consider the quantity of noxious air and the destruction of vital air both ways?—Yes, provided that is the way you state it.

I want to know whether you accede to that?—I stated all the conditions, and my statement alluded to the passage of an engine up the tunnel from one end to the other. The passengers who descend being free from annoyance, is no relief to the passengers ascending.

That sounds very clear and very amusing to my learned friend; but when we are upon the consumption of vital air, practically speaking, and trains working both ways, and passengers going both ways, am I not entitled to consider there is no consumption of vital air one way?—Yes.

Is it ridiculous to suppose that?—No.

Is it not an absolute fact?—Yes, it is.

Then it ought to be as fifteen to nine?—No, certainly not; not so far as regards any effect produced upon passengers.

You mean, when any effect is produced, it is as thirty to nine?—If there happened to be two trains passing at the same time in opposite directions, all the passengers coming down would receive the ill effects as the passengers going up, without any one receiving any benefit from the descent.

Do you mean to state, that with trains going both ways the consumption of vital air in the tunnel is in the proportion of thirty to nine, compared to a level?—No, not with the same number of trains, but I have alluded to a single train during its passage.

And during the ascent?—During the ascent.

Then with respect to those two trains going in different directions at the same time, the consumption of air would in this tunnel, with respect to another tunnel with the same length on a level, be as eighteen to thirty?—Yes.

In favor of the level tunnel?—Yes; but that is a thing never likely to happen.

Are you not, in your calculations of the effect of the noxious air given out, assuming that for a moment there is no draught?—Yes, I am decidedly of that opinion. I do not think that the shafts in the tunnel would be found to produce any good effect for the passing engine, though they will probably ventilate it for the next train; but the passage through will be so quick that no effective ventilation will have time to take place for the passing engine.

Should you like a tunnel a mile long without shafts?—I think that the shafts will not be found to be the best means, and my opinion is, that they must ventilate long tunnels by other means.

Have you any practical experience upon that subject?—No, and no one has any practical experience in tunnels of this great length upon slopes.

Are you sure of that?—I do not know of any; I never saw or heard of them.

A tunnel of a mile long?—Worked by locomotive on a slope; I am not aware of any.

What is the longest tunnel you have known?—I know of no tunnel a mile long worked by locomotives.

Mr. Talbot.—Should you like a tunnel of a mile long without shafts as well as one with shafts?—I have no experience upon the subject.

You are a scientific gentleman of great eminence put into the box to favor us with your opinion; I want your opinion?—My opinion I have stated already, that I apprehend shafts will not produce a material relief for the passing train; they may, and probably will, ventilate for the next train. In the transition of the train through a certain length of the tunnel, there is not time for the ventilation to take effect. If the atmosphere in the tunnel be, as it ge-

nerally will be, still, then the engine, as it draws the train through, will produce a quantity of noxious and annoying air; that air will remain immediately behind it, and the train will instantly be involved in it, and one cannot suppose that there will be time for that air to go up the chimney or shaft between the passage of the engine and the passage of the train of passengers; and my idea is, that they will be obliged to resort to artificial means to carry off the foul air.

Mr. Talbot.—Why should not the train of carriages leave it behind?—So it will, and it involves the train; it is because they do leave it behind that it involves the passengers.

Suppose it rises to the roof in a tunnel thirty feet high, how much will it be above the train of passengers?—I cannot recollect the height of the carriages, twelve or fourteen feet.

The chimney is fifteen?—The carriages are very high; they go up a considerable height of the chimney.

There would be from fifteen to twenty feet between them and the roof of the tunnel?—Yes.

Do you think that this air is to rebound almost perpendicularly upon the train of carriages?—I have no doubt of it, from the velocity with which it comes from the chimney. I may state that there is a jet of high pressure steam turned upwards in the chimney; it is blown out of the engine, and it is presented perpendicularly upwards in the chimney. All the high-pressure steam that works the engine is blown with prodigious violence up the chimney; this carries with it the noxious air, and they are driven against the roof of the tunnel with this force; they do not go up with their natural force of draught, but they are carried up and strike the roof with force of the steam, which is so considerable that they would come down upon the first carriage like a ball rebounding.

I want to ask you to explain one thing, which to me requires explanation. You told their lordships that the acclivity of the slope had nothing to do with the strength of an endless rope, because it balanced itself?—Yes.

I should be glad to know how you explain that?—If you put an endless rope over a pulley actually perpendicular, which is the extreme case and the greatest acclivity, and apply the power to it to put it in motion round the pulley, you will require a certain force to do it; and if you put the same rope upon a level it will require the same force, because the rope balances itself.

If there was a pulley at the top of this room, and I put a thread over it in the one case, and a nine-inch rope in the other?—I am speaking of the same rope.

You stated that the acclivity had nothing to do with the strength, from which I infer that the same rope will do; am I wrong?—No, provided it is to draw the same load—not the same load because the acclivity makes a difference in the load, but I am speaking of the rope itself—so far as the rope itself goes it balances itself.

You mean with the same strain?—Yes.

(To be continued.)

Applications of Chemistry to the Useful Arts, being the substance of a Course of Lecture delivered in Columbia College, New-York, by James Renwick, Professor of Natural Experimental Philosophy and Chemistry.

Continued from page 155.

II.

NITRE.

History.—The nitrates of potassa, lime, and magnesia, are found in the soil in various places, and are probably frequently formed spontaneously. It is only, however, in warm climates that they are generated in the open ground in sufficient quantities to make them profitable objects of extraction. In colder climates, these salts occasionally form, in quantities worth collecting, in caverns, in cellars, and in damp buildings of masonry. The nitric acid which unites with earthy and alkaline bases to form these three salts, is formed by the absorption of its two elements, (oxygen and nitrogen,) from the atmosphere. This being suspected in France, a successful attempt was made to form artificial nitre beds, and thus a supply of this essential munition of war was obtained, when all access to the countries whence nitre had been previously obtained was prevented by the British fleets.

Rationale.—The theory of the formation of nitric acid from its elements, as they exist in the atmosphere, is not fully understood. The union does unquestionably take place by the passage of electricity; and the rain which accompanies lightning often exhibits traces of the acid; but the quantity thus produced is not sufficient to explain the large quantities of the nitrates which are found in some situations. We can only, therefore, state the circumstances which experience has shown to be necessary in order to the production of these nitrates. These are—

1. The presence in the soil of powerful alkaline or earthy bases, such as lime, magnesia, and potassa.

2. A certain degree of moisture, such as that in friable vegetable mould, after a gentle rain.

3. An elevated temperature in the air, as at the freezing point, the nitrates are not produced, and the process is not active below 70° of Fahrenheit.

4. The access of solar light, which seems to be absolutely necessary, although if it be so intense as to dry the soil, the action ceases altogether.

5. In temperate climates, animal matter disseminated through the soil must be present; and this is so essential, that, when artificial nitre beds were first formed, it was supposed that the nitric acid was altogether derived from the organic matter. But the quantity of the nitrates which are formed, is far greater than can be accounted for in this manner. It is therefore analagous to the case of ferments, where by the addition of a substance capable of entering into fermentation, that action may be induced in a great quantity of other fermentable matter, which might otherwise have remained unaltered.

Native Nitre Beds.—The salts contained in the nitric soils of Bengal, Ceylon and Egypt are, nitrate of potassa, (nitre,) nitrates of lime and magnesia, sulphates of lime and magnesia, and common salt. In Ceylon the soil is mixed with wood ashes, and lixiviated. The water in its passage dissolves not only the saline matter contained in the soil, but the potash of the wood ashes, and by it the earthy nitrates are decomposed and nitrate of potassa results. In Bengal the advantage of the use of alkaline matter does not seem to be understood, and the earthy nitrates are lost.

The leys obtained from the earth by passing water through it, until it flows off tasteless, are in these warm climates partly evaporated by exposure to the sun and air, and partly by boiling until the liquid is saturated. It is then poured into vessels where on its cooling the nitre crystalizes. The mother water contains the earthy nitrates, (if not decomposed,) with part of the sulphates and of the common salt. But the crystalized nitre is by no means pure, containing a portion of the last named salts, as well as organic matter, which are usually, taken together, as much as 25 per cent.

ARTIFICIAL NITRE BEDS.

AUTHORITY—DUMAS. Chimie appliquee aux Arts.

These have been formed in calcareous soils impregnated with animal matter, as beneath butchers' shambles, and in ancient burial grounds. But this method has gone out of use, with the necessities which gave it birth. The only operation necessary was to stir the earth frequently, so as to expose fresh surfaces to the air, and at the end of a few months, a sufficient quantity of nitrate of lime was formed to render the earth fit to lixiviate. To the liquor, containing the nitrate of lime, common potash was added, in sufficient quantity to insure the decomposition of this earthy salt. The nitrate of potassa thus formed, was obtained by concentrating the liquor by boiling, and crystalizing. It was in this manufacture, that the large quantities of potash exported from this country to the continent of Europe were principally used; and the consequent high price of this article had a most important influence upon the clearing of our forests, and bringing them into cultivation.

In Sweden, the nitrate of lime is procured, by placing in a small wooden hut, upon a floor of wood or well rammed clay, a mixture of common earth, marl, and ashes, to the depth of two or three feet. This is thoroughly moistened with the urine of cattle, and stirred up once a week.

At Longpont, in France, a nitre bed is formed in an ancient quarry in calcareous rock; in the bottom of this a bed of three or four feet in thickness is formed of alternate layers of earth and stable manure, and the washings of a stable are directed to it. At the end of two years the mass is moved into the light, and is frequently stirred for two years more, when it is fit for lixiviation.

In some places the earth is prepared for

the purpose by fencing sheep upon it. Their manure is removed every four months, and replaced by a layer of fresh earth. At the end of a year the sheep are taken off, and the earth is stirred, at intervals of two months, for two years more, taking care to keep it moist with the drainings of stables.

In Prussia, calcareous earth charged with animal matter, is formed into walls, by which the operation is rendered more rapid.

Upon the whole, these methods cannot be recommended as profitable objects of industry, but only as means which may be resorted to in cases of absolute necessity.

PURIFICATION OF NITRE.

AUTHORITY—DUMAS. Chimic appliquee aux Arts.

Crude nitre, or saltpetre, as it is imported from the East, contains about 25 per cent. of impurities. These are partly saline, and partly organic, the latter derived from the animal and vegetable matter which exists in the soil. In this state it is unfit for its most important uses in the arts, and therefore requires to be refined.

To refine the crude saltpetre, two successive solutions and crystalizations are usually performed. In the course of these, the organic matter is separated in consequence of its insolubility, and the greater part of the foreign salts are removed, by taking advantage of their relative degrees of solubility and manners of crystalization.

The first solution is performed by putting water into a copper boiler in the proportion of one-fifth of the weight of the saltpetre. To this the saltpetre is gradually added as the liquid is heated, and at the boiling temperature the whole of the nitre is dissolved. The insoluble matter rises to the top of this dense solution, and may be skimmed off. In order to facilitate the formation of the scum, a small quantity of glue, dissolved in water, is added to the solution; this will carry with it, to the surface, all the matter suspended in the liquid. Cold water is also thrown upon the surface of the liquid, from time to time, in order to check the ebullition and permit the formation of the scum. After the last skimming, when no more solid matter appears at the surface, the liquid is made to boil violently for a short time, after which the fire is permitted to expire gradually. The liquor ceasing to boil, the saline matters which are not soluble in the quantity of water which is present, sink to the bottom of the vessel, where they are left by the decantation of the solution, while still hot. The solution is received in copper basins, which are covered with wooden lids, in order to render the cooling more gradual; in these basins all that portion of the nitre, which is more soluble in boiling than in cold water, will finally crystalize in the form of the basin.

The *loaf* thus formed is permitted to drain, by placing it on wooden shelves pierced with holes. The mother waters which run off, are still rich in nitre, and are preserved, as well as the scum of which we have spoken.

As these *loaves* have been formed by crystalization in water holding other salts in solution, the nitre, although much improved in quality, is still far from pure. It is therefore dissolved a second time in one-third of its weight of boiling water. The solution is treated with glue and skimmed as in the former case, and permitted to crystalize in copper basins. The loaves thus formed, are set aside to drain upon an inclined plane of wood, in which gutters are formed of sheet lead. These gutters convey the drainings to a common receptacle. The place in which the inclined plane is formed, must be sheltered from the weather, but have a free access of air. Several months will elapse before the loaves are thoroughly dried.

The scum is washed with caution, in order to separate the nitre which may have adhered to it, and the washings, with the drainings of the loaves, are concentrated by boiling until the solution is saturated, when they are permitted to crystalize. The washings of the scum of the second boiling give, on their first crystalization, nitre of excellent quality; they are therefore heated by themselves. The drainings and washings of the first boiling are usually returned to the boiler during the first operation. If earthy nitrates be present they are converted into nitre, and their bases precipitated, by adding sub-carbonate of potassa, (common potash,) as long as effervescence continues, to the drainings of the loaves.

An improved process has recently been introduced, in which nitre may be refined by a single solution and crystalization. To the water in the boiler, twice its weight of crude nitre is added, while cold; this quantity is increased as the liquid heats, until it amounts to five times the weight of the water. After the boiling has commenced, it is checked from time to time by the addition of cold water, in order that the insoluble matters may fall to the bottom, whence they are scraped out. The liquid is treated with glue, as before, and finally, by the addition of cold water, the quantiy of that liquid is increased to one-third of the weight of the saltpetre. When this liquid, by repeated skimmings, has become perfectly clear, the fire is permitted to expire, until no more is left than will prevent the liquid from cooling below 190° Fahr.

After the interval of a night, this liquid is removed by means of copper ladles, taking care not to disturb the sediment, which with the turbid portion of the liquor is left behind. The liquid is emptied from the ladles into a vessel of the form represented in plate 3.

PLATE III.

Fig. 1.

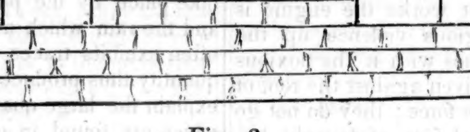


Fig. 2.

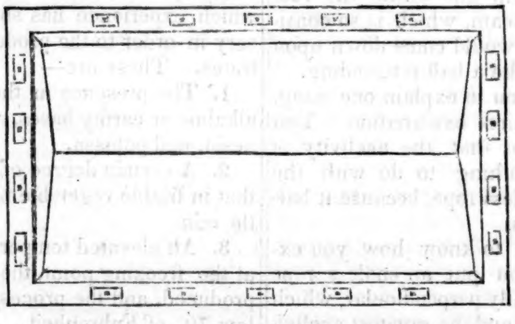


Fig. 1, section of vessel for crystalizing nitre.

Fig. 2, plan of do.

In these vessels the liquid is permitted to cool. As it cools, nitre is deposited in slender crystals, which are removed by rakes as they form, and heaped upon the inclined edges of the vessel, in which position the adhering liquid rapidly drains off. As soon as by draining, the nitre has lost its transparency, and become white, it is removed by means of copper shovels to a wooden bin. This has the figure of a truncated pyramid, with a false bottom, piercedwith holes. Beneath the false bottom a hole is bored in one of the sides of the bin, to which a spiggot is adapted, as represented in plate 4.

Fig. 1, plan of a bin for purifying nitre by washing.

Fig. 2, transverse section of do.

Fig. 3, longitudinal section.

bb, false bottom pierced with holes.

s, spiggot.

In these bins the nitre is heaped up, until the middle of the heap is about six inches higher than the edges of the bin. It is then washed alternately with a saturated solution of pure nitre, and with pure water. After the liquor of each successive washing has remained for about three hours in contact with the nitre, the hole near the bottom of the bin is opened by withdrawing the spiggot, and the liquor is allowed to drain off. The washing is completed when the liquid, tested by the hydrometer, has the exact density of a saturated solution of pure nitre at the temperature of the experiment. In operating upon 3000 pounds avoirdupoise

PLATE IV.

Fig. 1.

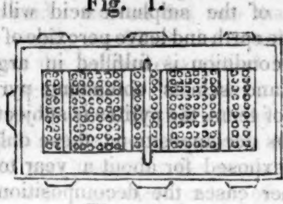


Fig. 2.

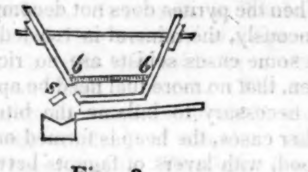
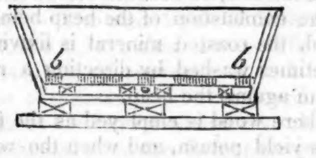


Fig. 3.



of crude saltpetre, 360 pints* of water are usually employed, in three successive washings. The first is composed of 150 pints of water, saturated with pure nitre; the second of 150 pints of purè water; and the third of 60 pints of water, saturatedwith nitre. The nitre having remained five or six days in the bins, is removed to a stove, in which it is dried. This stove is usually heated by the waste flame and smoke of the boiler, in which the solution of another parcel of nitre is going on. During the drying, the nitre must be frequently stirred, in order to prevent it from sticking to the sides and bottom of the stove. It is thus brought to the form of a white powder. Three thousand pounds of crude saltpetre, treated in this way, give 1750 to 1800 pounds of nitre of great purity.

The mother water of the boiling, and the liquid which drains from the first washing, are impure; the liquor of the third washing, and the latter part of the second, are sufficiently pure to be employed in the subsequent washings. The impure liquors are concentrated by boiling, treated with glue, and finally with carbonate of potassa, in order to decompose the earthy nitrates. Being then permitted to crystalize, and washed as before, they yield nitre of great purity.

MANUFACTURE OF GUNPOWDER.

AUTHORITY—DUMAS. Chimie appliquee aux Arts.

Rationale.—The nitrate of potassa, (nitre,) when rapidly heated is decomposed, giving out oxygen, nitrogen, nitrous acid, and nitric oxide, in their gaseous form. This decomposition is rendered more rapid by the presence of combustible bodies, and particularly of carbon in any of its more usual forms, which causes the gases to be evolved in such quantities as to produce detonation. By its action also, the oxygen is converted into carbonic oxide and carbonic acid. In order that the detonation may be certainly and readily produced, the carbon and nitre should be mixed with a substance which has the properties of taking fire at a low temperature, and of producing an elevated temperature by its combustion. Sulphur has these properties, and in addition, it appears that when it is heated in contact with carbon and nitre, a sulphuret of potassium is formed, which is even more inflammable than sulphur itself.

In order that the sulphur shall begin to burn, it is necessary that it be in contact with air, but the combustion may be kept up afterwards by the oxygen furnished by the decomposition of the nitre. As the sulphur is thus converted into sulphurous acid, and the heat generated is sufficient to render potassa volatile, the whole product of a mixture in proper proportions, may be gaseous, and this is the rationale of the common test of the quality of gunpowder, namely, to flash it from a shallow cup of brass placed upon a sheet of white paper, to which, if pure and in due proportion, it will communicate no stain.

Manufacture.—Gunpowder is made up of the three substances of which we have spoken: nitre, carbon in the form of charcoal, and sulphur.

In order to make good gunpowder, these articles must be of the best quality.

The nitre must be refined by either of the processes which have been described; of these the last yields it in the most convenient form.

Instead of the ordinary mode of purifying sulphur, a method invented by Michel, of Marseilles, is to be preferreed. In this,* crude sulphur is sublimed from a large iron kettle, which acts as a retort, capable of holding 15 or 1600 lbs. of sulphur, and which is charged with 1000 to 1250 lbs.—The upper part and neck of the retort are supplied by a dome and flue b ilt of brick. The flue terminates in a brick chamber, which serves as a receiver. If flowers of sulphur are required, the chamber is large; but when masses in the form of cylinders (roll brimstone,) are needed, it is of smaller size. The first sulphur which passes over will burn in the oxygen of the air contained in the chamber. The chamber must therefore be furnished with valves, in order to let off the fumes, but which will prevent the entrance of atmospheric air. When the oxygen is exhausted, the sulphur will begin to form crystals (flowers of sulphur), on the walls and ceiling of the chamber, by which they will be heated until the vapor of the sulphur will condense in a liquid form on the floor. Hence it is withdrawn from time to time into proper moulds.

The charcoal must be made of soft wood, (willow, poplar, or alder,) and in some countries it is prepared for this purpose from the hemp plant. Soft wood is better than hard, inasmuch as the charcoal prepared from it is less charged with earthy and alkaline matter, and less liable to be inflamed by friction. The best mode of preparing the charcoal is by the distillation of the wood in iron cylinders, as we shall have occasion to describe under the proper head. The wood should not be of more than 5 or 6 years' growth, and should be stripped of its bark; for old wood contains more earthy and alkaline matter than young, and the bark more than the body of the tree. It ought to be cut when full of sap.

Long experience has brought the proportions of the three substances which enter into the composition of gunpowder, to that relation which the most accurate experiments, and the most severe consideration of the theory of their action, would have pointed out. Three principal descriptions of gunpowder are manufactured in the following proportions, although there is some variety among manufacturers in this respect.

Government Powder.

	For ordnance.	For mines	Powder for fowling pieces.
Nitre,	75	65	78
Sulphur,	$12\frac{1}{2}$	20	10
Charcoal,	$12\frac{1}{2}$	15	12

The first of these proportions insures the most rapid combustion of the gunpowder, and under favorable circumstances a complete decomposition of the nitre. The second burns with less heat, but produces more gas. In the first, if the combustion be complete, no excess of sulphur remains to act upon the metal of the fire arms, but as the powder may be damp, the third composition, although it produces less gas than either of the others, and less heat, is preferred in some cases; for, in consequence of the excess of oxygen produced by the nitre, there is less danger of the pieces becoming foul. The second composition, on the other hand, would speedily render small arms unfit for service.

In the preparation of gunpowder the charcoal and sulphur are first mixed together, by grinding them to powder. The nitre is then added, and the grinding continued until they are thoroughly incorporated in the form of a fine *meal*. The grinding was originally performed in wooden mortars, by means of wooden pestles; the latter are lifted by a water wheel, or other power, and fall by their own weight. They were originally of the form of a cylinder, but are now usually made of the shape of a pear. In some establishments the grinding is performed in cylinders, or drums, revolving around a horizontal axis. Within these are placed balls of an alloy of copper when the charcoal and sulphur are ground, and of tin when the three ingredients are to be incorporated.—In both methods the mixture is kept in a moist state, in order that it may be less inflammable.

Gunpowder in the form of meal burns slowly in consequence of there being but little air in contact with the sulphur, except at the surface of the mass. In order to give air access to the interior of a parcel, the gunpowder is formed into grains. The size of these grains varies according to the use, being largest for the charging of cannon, and smallest for small arms. In order to form meal gunpowder into grains, it is, while still moist, forced through seives, the meshes of which have a size adapted to that of the desired grains. The seives are made of leather, pierced with holes by a machine constructed for the purpose. The dust which forms is next sifted off, and returned to the moistened heap. For the military and na-

* Standard liquid measure of the State of New-York, which is to be always understood unless otherwise expressed.

* See DUMAS. Article Soufre.

val service it only remains to dry the grains. This may be done, either by exposure to the sun and air, or in a chamber heated by a stove. The granulation was formerly wholly performed by hand, but of late machinery has been invented for the purpose.

For fowling pieces it is usual to *glaze* the gunpowder. This is done by placing dry granulated powder in a barrel, revolving on a horizontal axis, and the polish of the surface is produced by the mutual friction of the grains.

Grains of a spherical figure are now manufactured. This form is preferred in service, and can be obtained at less expense, as the granulation is effected by a simpler machinery.

The machine for making round grains is a drum or hollow cylinder, about a yard in diameter, and from 12 to 16 inches in thickness. This is affixed to a horizontal axle, around which a tube is adjusted that communicates with a reservoir of water. The tube being pierced with small holes, the head of water causes that liquid to issue from them in a shower of drops. Dry meal gunpowder is introduced into this drum, and during the revolution always tends to occupy its lower part. Upon this the drops fall, and roll; each of them thus becomes the nucleus of a spherical mass, whose size will depend upon the time that the revolution is kept up. The globules are sorted, by passing them through seives, and dried. By cutting off the supply of water, the same apparatus will glaze the grains.

3. BORAX.

Borax is a combination of boracic acid with soda, in which the alkaline matter is in such excess that it retains an alkaline reaction. This salt is found native in many parts of the globe, but is principally procured from a lake in Thibet. In its raw state it is mixed with an oleaginous matter, probaby of vegetable origin, and with other salts of the same acid.

In order to purify it, it is reduced to powder, thrown upon a filtering cloth, and washed with a weak solution of soda, until the liquor passes off free from color. In this process, the soda forms a soap with the oleaginous matter, which is readily dissolved.

It is next dissolved in boiling water, in such quantity that the solution may have a density of 1.17.* Twelve parts of subcarbonate of soda for each 100 pts. of the borax are added to the solution, in order to decompose the other salts; and the liquor is filtered, in order to separate the precipitates. The liquor is again boiled, and then emptied into vessels of a conical or pyramidal form, in order that it may crystalize. These vessels are lined with sheet lead. In order to obtain the borax in separate terminated crystals, the rate of cooling in these vessels must be extremely slow.

Besides the lakes which furnish this subborate of soda, there are in Tuscany springs which yield boracic acid. These have recently been applied as sources of borax. At these springs, the boracic acid is now prepared by evaporation, in its crystaline form. In order to obtain borax, 600 lbs. of carbonate of soda are dissolved in 500 pints of boiling water, and 500 lbs. of crystalized boracic acid are gradually added to the solution. As the decomposition of the carbonate is attended with violent effervescence, the vessel must be at least twice as large as is necessary to contain the liquid. The solution being saturated by boiling, is crystalized as rapidly as possible, by cooling. The crystals are again dissolved in boiling water, to which 10 pts. of carbonate of soda are added, in order to decompose the earthy borates, arising from the impurities of the soda of commerce. It is then crystalized in the mode above described.

* 20° of Beaume.

4. ALUM.

History.—Alum is a double salt, composed of sulphuric acid, soda, and an alkali. It is a native product in the vicinity of volcanoes, whence it is sometimes extracted for use. It was first imported into Europe from Rocca (Edessa) in Syria, whence the name of Rock-alum frequently given to its crystals. A Genoese of the name of De Castro having noticed the mineral whence the Syrian alum is obtained, discovered the same substance in Italy, and introduced a similar manufacture at Tolfa. After the chemical nature of alum was discovered, it was found that a sulphate of alumina was often formed spontaneously, by the decomposition of iron pyrites in argillaceous rock, and that a similar decomposition might be produced, by roasting clay-slates rich in sulphuret of iron. These were therefore next employed in the manufacture of alum. Finally, since the great improvement in the manufacture of sulphuric acid, the acid and the earthy base have been combined directly.

MANUFACTURE OF ALUM FROM THE NATIVE ALUM OF TOLFA.

AUTHORITY.—DUMAS. Chimic appliquee aux Arts.

This mineral contains the proper proportions of the sulphates of alumina and potassa, united to a definite proportion of hydrate of alumina. The separation of the salts from the earthy matter cannot be effected until the water is separated from the hydrate. For this purpose the mineral is broken into fragments and calcined in a furnace, regulating the heat in such manner that the sulphates shall not be decomposed. The calcination being finished, the roasted mineral is placed on a level earthen floor, in layers, each of which is sprinkled with water. The mass gradually assumes the form of a paste, and is ready to be lixiviated at the end of a couple of months. The lixiviation gives a (cold) saturated solution of alum, mixed with a turbid sediment. The liquor is evaporated by boiling in leaden vessels, until ready to crystalize, and is then permitted to cool. The crystals which are deposited first are octoedral; the next are cubo-octoedral; and the last cubic. The cubic form is now known to be owing to an excess of alumina.

MANUFACTURE OF ALUM FROM PYRITICAL SLATES AND SCHISTS.

AUTHORITY.—DUMAS. Chimic appliquee aux Arts.

The decomposition of iron pyrites spontaneously, or by the aid of heat, yields the sulphates of the protoxide and black oxide of iron. If, however, alumina be present and the decomposition be complete, the whole of the sulphuric acid will combine with the earth and leave peroxide of iron free. This condition is fulfilled in argillaceous slates and schists containing pyrites. In some of them, the pyrites is subject to spontaneous decomposition; these only require to be exposed for about a year to the air. In other cases the decomposition may be effected by pouring water on the slate. When the pyrites does not decompose spontaneously, the mineral is roasted in heaps. In some cases schists are so rich in bitumen, that no more fuel need be applied, than is necessary to inflame the bitumen. In other cases, the heap is formed on a floor of wood, with layers of faggots between those of the mineral, or built into strata with coal.

The combustion of the heap being completed, the roasted mineral is lixiviated, or sometimes washed by directing a running stream against the heap.

Where wood is employed as the fuel, its ashes yield potasa, and when the wood is burned with coal, ammonia is produced. In either case, a portion of the sulphate of alumina will be converted into alum.

The liquor produced by lixiviation is concentrated by boiling, to a density of 1.333.* It is then permitted to rest for five or six hours, in order that the insoluble salts, and particularly those of the peroxide of iron, may settle. Being next placed in crystalizing vessels, the greater part of the alum which has been formed by the ashes of the fuel, is deposited in a crystaline form. The liquor is then repeatedly concentrated by boiling, and allowed to cool; at each successive stage of which, crystals of the sulphate of the protoxide of iron are left. Finally, the liquor becomes thick and viscid, from the presence of the deliquescent sulphate of alumina. This liquid, by the addition of sulphate of potassa, or sulphate of alumina, or of both, is converted into alum, which is precipitated in the form of powder. In order to give it the crystaline character, the powder must be dissolved in boiling water, and permitted to cool.

The persons who work aluminous slates and shales usually sell the sulphate of alumina to others, whose specific business is the manufacture of alum. In this case, the viscid liquor is evaporated to dryness, and the purchaser re-dissolves it. The dry sulphate of alumina has the consistence of grease or tallow.

MANUFACTURE OF ALUM BY THE DIRECT UNION OF ITS COMPONENTS.

AUTTHORITY.—DUMAS. Chimic appliquee aux Arts.

The clays (silicates of alumina) which are best fitted for this process, are such as are as free as possible from carbonate of lime and the oxides of iron. Such clay is roasted in a furnace, until it becomes capable of being readily pulverized. By this calcination, the principal part of the water is driven off, any iron which may be present oxidated to the highest degree, and the action of the sulphuric acid on the alumina facilitated.

The clay is next pulverized with care, and passed through bolting cloths, in order to

* 36° of Beaume.

exclude the coarser parts. This fine powder is then formed into a paste with dilute sulphuric acid; and as the two manufactures are usually combined, the liquid which comes from the leaden chambers* is used without concentration. Forty-five parts of this are mixed with 100 parts of clay. The mixture is placed in a stone basin covered by a vault, and heated by the smoke of the furnace in which another parcel of clay is undergoing the process of roasting, or by other waste heat. It remains in this basin several days, during which it is frequently stirred, and is then laid aside in a warm place, for more than a month. The mass is then repeatedly washed with water, which separates the sulphate of alumina which may have been formed. The liquor is concentrated to 1.17*, permitted to settle and decanted. The clear liquor is further concentrated to 1.21†, if the alum is to be formed by sulphate of ammonia, or to 1.38‡, if sulphate of potassa is to be employed. The subsequent concentration and crystalization are conducted as in the former cases.

The alum of commerce is rarely free from sulphate of iron. This renders it unfit for some of the arts, and particularly for dyeing silk. Alum in a sufficient state of purity for this purpose may be obtained by dissolving the alum of commerce in boiling water, in such quantity that the density of the solution may not exceed 1.26§. The solution, on cooling, deposits small crystals, which are free from the metallic sulphate. The mother water, on concentration and cyrstalization, yields common alum.

Alum is sometimes transformed into an accetate of alumina, which is better adapted to some purposes in the art of dyeing. This process may be conveniently included under this head.

PREPARATION OF ACETATE OF ALUMINA FROM ALUM.

AUTHORITY.—VITALIS. Cours de Teinture.

Three parts of purified alum, and one of acetate of lead, are dissolved in eight parts of boiling water. The solution being completed, 1-8th of a part of potash, and as much chalk, are added. The mixture is stirred at intervals, for a few hours. It is then permitted to rest, and when the precipitate has settled, the liquor is decanted. The solution still contains the alkaline sulphate which formed a part of the alum, but this does not impair its qualities. As the acetate of alumina does not crystalize, the solution is preserved in its liquid state for use.

5. SUPER-TARTRATE OF POTASSA—(CREAM OF TARTAR.)

AUTHORITY.—VITALIS. Cours de Teinture.

The *tartar* which collects on wine casks is this super-tartrate mixed with the coloring matter of the grape, and with tartrate of lime. In order to purify it, the crude tartar is reduced to powder, and dissolved in boiling water. The solution is decanted into vessels where the salt crystalizes on cooling, in a state almost colorless. To separate the residue of the coloring matter, it is again dissolved in boiling water, to which four or five per cent. of clay is added. The liquid is boiled until a thick pellicle of the salt has formed at its surface. During the boiling, the coloring matter will have combined with the alumina of the clay, and on crystalization, a colorless substance is obtained.

The five salts whose preparation has been described above, are the most important of those with alkaline and earthy bases which are prepared on a large scale for use in the arts. In the sequel, we shall have occasion to treat of some of their most important applications. The preparation of the metallic salts can be more appropriately considered under the head of the metals.

*See "Manufacture of Sulphuric Acid." SUPRA.
*20° of Beaume. †25° of Beaume. ‡40° of Beaume. § 30° of Beaume.

AGRICULTURE, &c.

A DISSERTATION ON THE MULE,

With the view of promoting an improvement in the breed; and of demonstrating the utility of employing him as a substitute for the horse, in the labors of husbandry, canals, &c. BY SAMUEL WYLLYS POMEROY.

"—OPINION is the queen of the world; it gives motion to the springs and direction to the wheels of power."—JOHN QUINCY ADAMS.

"Knowledge is power."—BACON.

(Concluded from our last.)

"As to my opinion of the value of mules, I shall always appear extravagant. I have scarce a horse on my estates for agricultural purposes, nor would I except of one as a gift, (except for road wagons,) of which I have no need, as my property lies upon navigable water. Nothing ever was so good as mules for the uses of this, our southern country; they live longer, eat less, and above all, are better suited to our slaves, than any other animal could possibly be: their strength, patient endurance of privation and hardships, slender pasturage, exposure—and in short, all those ills to which animals are subject where slaves are their masters, give to mules a decided preference in all the agricultural states of the south.

"I do not know of any being trained to the purposes of pleasure carriages. They are often ridden, and go pleasantly, with great surety of foot. I have no doubt, but that in time they will generally be used for carriages, and would particularly suit mail coaches; they are very swift, and have great durability in travelling."

The *Knight of Malta*, mentioned by Mr. Custis, was unquestionably the first Maltese Jack ever brought to the United States. The second came in the frigate Constitution, on her return, I think, from her first cruise in the Mediterranean; and, I have understood, was sold in the District of Columbia, or one of the adjoining states. Since that time a number have been introduced by officers of the *navy* from *Malta*, and the large *Spanish breed* from *Minorca* and *Majorca*. From the Mount Vernon and those stocks, some fine mules have been bred in the middle states, and probably farther south. A few valuable *Maltese* Jacks have been imported in merchant ships.

The impressions received, when on a visit to the West Indies in my youth, by observing, on the sugar plantations, the severe labour performed by mules in *cane* mills, induced me, when I commenced farming, to purchase the first well broke mule I could light on; and notwithstanding he was so small as to require a vehicle and harness constructed purposely for him, his services were found so valuable, and the economy of using those animals so evident, that I was stimulated to great exertions for procuring several others of larger size; in this I succeeded, after great difficulty, to such an extent, as to have had more labour performed by them on *farm* and *road*, for thirty years past, than any person I presume, in New England; and every day's experience has served to fortify my conviction of the superior utility of the mule over the horse, for all the purposes for which I have proposed him as a candidate. And it should be considered, that those I have used were of an ordinary breed, vastly inferior to such as may be easily produced in our country, by attention to the introduction of a suitable race of *Jacks*, and a proper system of breeding and management. The question occurs how is this to be effected? I will premise, that there exists a strong analogy between three varieties of the horse, and those of the domestic ass, considered the most valuable. We have the *Arabian*, the *hunter*, and the stout *cart-horse*. There is the heavy *Spanish Jack*, with long slouching ears, which Mr. Custis has described, that answers to the cart-horse; another Spanish breed called the *Andalusian*, with ears shorter and erect, of tolerable size, plenty of bone, active, more spirited, and answering to the hunter. Then comes the *Arabian Jack*, with ears always erect, of a delicate form, fine limbs, and full of fire and spirit. Judicious crosses from these varieties, will be requisite to produce such kind of mules as may be wanted for general purposes. From the small Jack of *African* origin, with a *list* down his back and shoulders, are bred a small race of mules, by far the most hardy of any. With attention to selection in breeding the Jacks, with, perhaps, a *dash* of some cross of the foregoing description, a stock of mules may be produced, preferable to all others, for the light lands and cotton culture of the middle and southern states.

To procure any number of *Arabian* Jacks from their native country, is hardly practicable at the present time. *Egypt* has been celebrated by Sonnini and other travellers, for superb Jacks of the Arabian breed, which probably has been often improved by those introduced by the Pilgrims from Mecca. I apprehend no great difficulty in obtaining them from that country. There is, however, no question but the *Maltese* Jacks are of the *Arabian* race, more or less degenerated. The most of those brought to this country, that I have seen, were selected on account of their *size*, and had been used to the draught. I should recommend the selection of those that are esteemed most suitable for the *saddle*, as likely to possess greater *purity of blood*. A Jack of this kind was, a number of years since, imported from Gibraltar, that had been selected by a British officer at Malta; and very much resembled the *Knight of Malta* described by Mr. Custis. I found, upon a careful examination, that he differed but little from the description I had heard and read of the true *Arabian* race; indeed I could discover some prominent points and marks, those found by Professor Pallas, to belong to the *Hemionus*, or wild mule of Mongalia. From this Jack I have bred a stock out of a large *Spanish Jennet* of the *Andalusian* breed, that correspond very minutely with Mr. Custis's description of *Compound*, bred by General Washington, and also a *mule* that now, not three years old, stands fifteen hands, and has other points of great promise.

Such have been the ravages of war and anarchy in Spain for a long time past, that

the fine race of *Jacks* that country once possessed have become almost extinct. In Majorca and probably, some part of the coast of Spain opposite, the large breed may be obtained: and there formerly was a superior race in *Andalusia*, which, it is hoped, have been preserved. Crosses on one of these breeds, by the *Arabian* or *Maltese*, I consider indispensable to furnish a race of Jacks for the production of the most desirable mules, uniting the weight and bone of one, with the spirit and vigor of the other; although their height will in a great measure depend on the mares, yet if sired by full blooded Maltese Jacks, their limbs are too slender and their pasterns too long for heavy draught; but for the *saddle*, especially from blood mares, they are admirable, and out of stout mares suitable for light carriages.

My attention has been but lately directed to breeding mules; and those intended only for my own use. The system adopted is to halter them at four months, and have the mules emasculated before six months old; which has great influence on their future conduct, and is attended with much less hazard and trouble than if delayed until they are one or two years old, as in the general practice. If they are treated *gently* and fed occasionally out of the hand, with *corn, potatoes*, &c., they soon become attached; and when they find that "every man's hand is not against them," will have no propensity to direct their heels against them, and soon forget they have the power. In winter they should be tied up in separate stalls, and often rubbed down. By such treatment there is not more danger of having a vicious mule than a vicious horse—and I am decidedly of opinion, that a high spirited mule, so managed and well broke, will not jeopardize the lives or limbs of men, women, or children by any means so much as a high spirited horse, however well he may have been trained.

The longevity of the mule has become so proverbial, that a purchaser seldom inquires his age. *Pliny* gives an account of one, from Grecian history, that was *eighty years old*; and, though past labor, followed others that were carrying materials to build the temple of *Minerva* at Athens, and seemed to wish to assist them; which so pleased the people, that they ordered he should have free *egress* to the grain market. Dr. Rees mentions *two* that were *seventy years old* in England. I saw myself in the West Indies, a mule perform his task in a *cane mill*, that his owner assured me was forty years old. I now own a *mare* mule, *twenty five years old*, that I have had in constant work twenty-one years, and can discover no diminution in her powers; she has within a year past often taken upwards of a ton weight in a wagon to Boston, a distance of more than five miles. A gentleman in my neighborhood has owned a very large mule about fourteen years that cannot be less than twenty-eight years old. He informed me a few days since, that he could not perceive the least failure in him, and would not exchange him for any farm-horse in the country. And I am just informed, from a source entitled to perfect confidence, that a highly respectable gentleman and eminent agriculturist, near *Centreville*, on the Eastern shore of *Maryland*, owns a mule that is *thirty five years old*, as capable of labor as at any former period.

The great Roman naturalist, in one of the most beautiful passages of his elaborate history of nature, observes that "*the earth is constantly teazed, more to furnish the luxuries of man than his necessities.*"* We can have no doubt but that the remark applied with great justice to the habits of the Romans in the time of Pliny; and I am much mistaken if ample proofs cannot be adduced that it will lose none of its force or *truth*, at this present period, in all northern climates, or any section of the United States, where the horse is employed for *agriculture* as well as for pleasure. Far be it from me, however, to disparage this noble animal, on the contrary, I feel a strong attachment for him; and at the same time a full conviction, that the substitution of the *mule* for the purposes before stated, as extensively as may be consistent with the requisite production of each species will have the effect of restoring the horse to the station from which he has been degraded, and place him, as in former ages, upon a more dignified footing—an object of *acknowledged* luxury; and thereby introduce a more correct system of breeding and management, in which our countrymen are so generally deficient, consequently more perfect animals, and such an advance in the price of them, that will afford the farmer what he is now a stranger to: such remuneration as will make his *brood mares* a profitable species of stock. And it is obvious, that the system will be followed by an improvement in the breed of *mules*, in the same ratio as the miserable race of *scrub* mares, which are now consuming the profits of agriculture, shall become extinct.

It does not appear that the horse was employed by the *ancients* for any purpose of husbandry. The *ox* and *ass* drew the *plough* and the *wain*, and performed all kinds of drudgery until after the *feudal system* was established in Europe; when the numerous *retainers* of the *feudal lords*, who held their lands by the TENURE of performing *knight's service*, found themselves under the necessity of making the horses they were obliged to keep, contribute towards their support in the cultivation. From this time, I believe, we may date, and to this cause may be attributed the introduction of the *horse* for the purposes of agriculture. Since that period, the history of Europe is little else than the annals of *war* and its preparations; and no material for that *scourge*, except the deluded *human victims*, seems more necessary than the horse; accordingly we find, that throughout the whole country, from the *Rhine* or the *Seine*, to beyond the *Danube* and *Vistula*, which has been the principal *arena*, the system of agriculture has embraced, extensively, the breeding of horses of different grades and forms adapted to the several uses in war. Indeed whole provinces were appropriated almost exclusively to the rearing those animals for disposal to the different combatants; and it must be obvious that their general use in husbandry, at the same time, would follow as a necessary consequence. It cannot be expected, therefore, but that the *Dutch* and *Germans* who have emigrated to our country, should bring with them such strong predilections for the horse, which have continued with most of their descendants, especially in those sections where communities of that respectable and industrious portion of our population have been located.—In *Great Britain*, to the causes which have produced the effects described on the continent, may be added the insular position of the United Kingdoms, vulnerable from numberless and distant points, the horse has been considered, in connection with the unconquerable spirit of the nation, as one of the most efficient means of repelling invasion. A circumstance that would of itself be sufficient to account for the *overweaning* attachment to this animal. But identified, as his services have been for a long period, with the convenience, sports, and recreations of all ranks and classes, and the science of *breeding* and *training*, forming a characteristic feature, it could not excite surprise, if the approach of that terrible spectre, *famine*, should produce little or no effect in the reduction of the number. And, although some of the most distinguished characters in the nation, eminent for their practical knowledge in rural economy, have been for half a century advocating the substitution of the ox for the purposes of agriculture, and demonstrating the feasibility, economy, and vast saving of food, yet it is said the number of laboring oxen have lately diminished, and horses increased. FIVE MILLIONS of the latter are now supposed to subsist in the United Kingdom, and two-thirds employed in husbandry—consuming, at a moderate estimate, the product of *twenty millions* of highly cultivated acres! And what is the consequence? *Consumption* follows so closely upon *supply*, that at every season of *harvest, let the preceding one be never so abundant*, fast sailing vessels are found in the various ports with their anchors *atrip*, to convey intelligence of the *result* to all parts of the world where a surplus of bread corn is grown—exciting such an interest in our own country, that the *farmer* on the shores of *Erie* and *Ontario*, and on the banks of the Ohio, may be seen reading *bulletins* of *British weather*—the *rain* and *sunshine* of every day in *August* and the *two* following months—often within thirty days after the time of their publication in London or Liverpool. Can it be supposed that in a country, where an attachment to the horse borders so nearly upon *infatuation*, that the question of the utility of the *mule* as a substitute, would be seriously agitated, or engage scarce a momentary invegstiation?

In no country is the mule better adapted to all the purposes of husbandry, for which the horse is used, than in every section of our own. And it would be highly desirable to be able to exhibit a calculation of the actual saving, *in dollars and cents*, by his employment; but, unfortunately, no correct data can be had. And as I consider such calculations, unless founded upon experimental facts, *and those multiplied*, to be as "tinkling cymbals," I shall merely submit a *desultory* between the *mule* and the *horse*, derived from such facts as my own experience, and information from authentic sources, will justify the assumption of.

From what has been stated respecting the longevity of the mule, I think it may be fairly assumed that he does not deteriorate more rapidly after *twenty* years of age than the horse after *ten*, allowing the same extent of work and similar treatment of each. The contrast in the mule's freedom from malady or disease, compared with the horse, is no less striking. Arthur Young, during his tour in Ireland, was informed that a gentleman had lost several fine mules by feeding them on wheat straw cut. And I have been informed that a *mule dealer* in the western part of New-York, attributed the loss of a number of young mules,

* "It is earth, that, like a kind mother, receives us at our birth, and sustains us when born. It is this alone of all the elements around us, that is never found an enemy to man. The body of waters deluge him with rains, oppress him with hail, and drown him with inundations; the air rushes on in storms, prepares the tempest, or lights up the volcano; but the earth, gentle and indulgent, ever subservient to the wants of man, spreads his walks with flowers, and his table with plenty, returns with interest every good committed to her care; and though she produces the poison, she still supplies the antidote; though CONSTANTLY TEAZED MORE TO FURNISH THE LUXURIES OF MAN THAN HIS NECESSITIES, yet, even to the last, she continues her kind indulgence, and when life is over, she piously hides his remains in her bosom."—[Pliny's Natural History, Book ii, Ch. 63.]

in a severe winter, when his hay was exhausted, to feeding them exclusively on cut straw and Indian corn meal. In no other instance have I ever heard or known of a mule being attacked with any disorder or complaint except two or three cases of inflammation of the *intestines*, caused by gross neglect in permitting them to remain exposed to cold and wet, when in a high state of perspiration after severe labor, and drinking to excess of cold water. From his light frame and more cautious movements, the mule is less subject to casualties than the horse. Indeed it is not improbable, but a farmer may work the same team of mules above *twenty years*, and never be presented with a *farrier's* bill, or find it necessary to exercise the art himself.

Sir John Sinclair, in his "Reports on the Agriculture of Scotland," remarks, that "if the whole period of a horse's labor be fifteen years, the first six may be equal in value to that of the remaining nine; therefore a horse of ten years old, after working six years, may be worth half his original value." He estimates the annual decline of a horse to be equal to 50 per cent. on his price every six years, and supposes one out of twenty-five that are regularly employed in agriculture, to die every year: constituting a charge of four per cent. per annum for insurance against diseases and accidents. He considers five acres of land, of medium quality, necessary for the maintenance of each horse, and the annual expense, including harness, shoeing, farriery, insurance and decline in value, allowing him to cost $200, to exceed that sum about *five per cent.*, which is the only difference between the estimate of this illustrious and accurate agriculturist, and that of a respectable committee of the *Farmers' Society of Barnwell District*, South Carolina, who, in a report published in the Charleston Courier, of 23d of February last, state, that "the annual expense of keeping a horse is equal to his value!" The same committee also state, that "at four years old, a horse will seldom sell for more than the expense of rearing him." That "the superiority of the *mule* over the horse, had long been appreciated by some of their most judicious planters; that two mules could be raised at less expense than one horse; that a mule is fit for service at an earlier age, if of sufficient size—will perform as much labor, and if attended to when first put to work, his gait and habits may be formed to suit the taste of the owner." This report may be considered a most valuable document, emanating, as it does, from enlightened *practical* farmers and planters, in a section of our country where we may suppose a horse can be maintained *cheaper* than in *Maryland*, or any State farther north.

I am convinced that the small breed of mules will consume less in proportion to the labor they are capable of performing, than the large race, but I shall confine the comparison to the latter—those that stand from fourteen and a half to he rising of fifteen hands, and equal to any labor that a horse is usually put to. From repeated experiments, in the course of two winters, I found that *three mules* of this description, that were constantly at work, consumed about the same quantity of *hay* and only one fourth the *provender* that was given to *two* middling sized *coach horses*, moderately worked. And from many years attentive observation, I am led to believe that a *large sized* mule will not require more than from *three-fifths* to *two-thirds* the food, to keep him in good order, that will be necessary or a horse performing the same extent of labor. Although a mule will work and endure on such mean and hard fare, that a horse would soon give out upon, he has an equal relish for that which is good, and it is strict economy to indulge him, for no animal will pay better for *extra keep* by *extra work*. But if by hard fare, or hard work, he is reduced to a *skeleton*, two or three weeks rest and good keeping will put him in flesh and high condition for labor. I have witnessed several such examples with subjects twenty years old; so much cannot be said of a *horse* at half that age. The expense of shoeing a mule, the year round, does not amount to more than *one-third* that of a horse, his hoofs being harder, more horny, and so slow in their growth, the shoes require no removal, and hold on till worn out; and the wear from the lightness of the animal, is much less.

In answer to the charge generally prevalent against the mule, that he is "*vicious, stubborn* and *slow*," I can assert, that out of about twenty that have been employed on my estate at different periods during the course of *thirty years*, and those picked up chiefly on account of their *size* and *spirit*, wherever they could be found, *one* only had any vicious propensities, and those might have been subdued by proper management when young. I have always found them *truer pullers* and *quicker travellers*, with a load, than horses. Their vision and hearing is much more accurate. I have used them in my *family carriage*, in a *gig*, and under the *saddle*, and have never known one to start or run from any object or noise; a fault in the horse that continually causes the maiming and death of numbers of human beings. The mule is more steady in his draught, and less likely to waste his strength, than the horse; hence more suitable to work with *oxen;* and as he walks faster, will habituate them to a quicker gait. But for none of the purposes of agriculture does his superiority appear more conspicuous than ploughing among crops; his feet being smaller, and follow each other so much more in a line, that he seldom treads down the ridges or crops. The facility of instructing him to obey *implicitly* the voice of his driver or the ploughman, is astonishing. The best ploughed tillage land I ever saw, I have had performed by two mules *tandem*, without lines or driver.

There is one plausible objection often urged against the mule, that "on *deep soils* and *deep roads*, his feet being so much smaller than those of the horse, sink farther in;" but it should be considered that he can extricate them with as much greater facility.

Few can be ignorant of the capacity of the mule to endure labor in a temperature of *heat* that would be destructive to the horse, who have any knowledge of the preference for him *merely on that account*, in the West Indies, and in the Southern States.

It is full time to bring our comparison to a close; which I shall do by assuming the position, that the *farmer* who substitutes *mules* for *horses*, will have this portion of his animal labor performed with the expense of *one spire of grass* instead of *two;* which may be equal, so far, to making "two spires grow where one grew before." For although a large sized mule will consume somewhat more than half the food necessary for a horse, as has been observed, yet if we take into the account the saving in expense of *shoeing*, *farriery*, and *insurance* against *diseases* and *accidents*, we may safely affirm that a clear saving of *one half* can be fully substantiated. But in addition to this, the *mule* farmer may calculate, with tolerable certainty, upon the continuation of his *capital* for *thirty years;* whereas the *horse* farmer, at the expiration of *fifteen years*, must look to his *crops*, to his *acres*, or a *Bank* for the renewal of his—or, perhaps, what is worse, he must commence *horse jockey* at an early period.

The intense interest with which the public mind is at present occupied on the subject of canals now in operation and progress, encourages me to offer the *mule* as an important *auxiliary* in the enconomy of their management; as, I trust, it will not be denied, that on the *cheapness* of transportation, on them depends their *utility* as well as *profit* to the stockholders. The mule seems so peculiarly adapted for the labor on canals, that compared with the horse, he may be considered almost equal to a *locomotive power engine*. Among the advantages we have enumerated respecting his use in husbandry, the most of which are applicable to canal labor, that of the much greater security from *diseases* and *casualties*, which must necessarily require a great number of supernumerary *horses*, to prevent interruption in the line of passage, is not the least important; nor is the very trifling expense at which the mule can be supported during the winter months, as he will bear being taken off his *feed* till the boats are about to be launched in the spring, and in a few days can be made fit for efficient duty—while a *horse* will require at least *half* feed *if he does nothing*, or must be *fed high* for some time before he can resume the labor that will be demanded of him. The same advantage may be derived by his employment on *railways*.

In a communication, published in the *Utica Observer*, the 16th of May, inst., by Henry Seymour, Esq., one of the *canal commissioners* of New-York, it is stated that a *packet-boat* on the Erie Canal, requires a team of *three* horses to tow sixteen miles—going eighty miles in the twenty-four hours, including stoppages and detention of locks; the *relays* demanding fifteen horses for each *nautical* day. If it takes five days for a boat to be towed from Lake Erie to the Hudson, *seventy five* horses will be required. I am not certain but it may be done in a little less time, but as there must always be supernumeraries kept, we shall be within bounds to estimate that number. In the same communication, the expense of each horse is estimated at *fifty cents* per day, I presume for subsistence *only*, without reference to *interest* or deterioration of *capital*, for the object of the estimate seems merely to show a *comparison* between the *packet boats* and *freight boats*, on a question of *profit and loss;* as it is remarked, that "many *contingent* expenses might be added to both." Taking this *data*, it will cost *thirty-five dollars* per day for the *horse* subsistence of a single packet boat. The *freight boats* require but *two*, and allowing for the time occupied in taking in and discharging their cargoes, with the other necessary detentions, averaging *forty miles* per day—which being double the time of the packet boats, although they may not require the same number of relays, the expense cannot materially differ. From these premises we may conclude, that for every boat navigating the *great Erie Canal*, there must be expended *three hundred and fifty dollars* for the subsistence of the *horses*, each time they tow her from the Lake to the Hudson and back. Now, if this can be done effectually by *mules* for one half this sum, and with an extension of *capital free of interest*, *fifteen years longer* than that vested in horses, the aggregate of this im-

mense saving will appear by ascertaining the number of boats at the present time on the canal. But this is out of my power; and I should, perhaps, lead the reader *nearer the verge of incredulity*, were I to offer my own prediction what that number *will* be thirty years hence, the ordinary period of a mule's labor, and which will then be some years less than a single century since the PRIME MOVER and GUARDIAN of this *stupendous undertaking*, the present Governor of New-York, first saw the light of heaven.

I cannot resist an impulse to exhibit the *mule* in one other point of view. For the movement of *machinery*, the employment of this animal, when judiciously selected, has met with a most decided preference, in comparison with the horse, independent of the *economy* in using him. And if we consider the rapid, and probably progressive increase of *labor-saving* machines, in every department where they can be made subservient to the requirements of society, it is evident that there will be a corresponding demand for *animal* power, as well as for that *more potent*, derived from the element; and although the *latter* may *vastly* predominate, yet should the horse be employed, and his increase for other purposes continue, as it now does, in the *ratio* of population, the number, at no very distant period, may become as alarming in our own, as it is at present in our *mother country*. And notwithstanding we may feel secure, from the extent of our territory and extreme diversity of *soil* and *climate*, but, above all, from being in possession of *Indian corn*—the GOLDEN FLEECE found by our "*pilgrim fathers*," when they first landed on these shores; yet such peculiar advantages may not insure us against the visitations of one of the most distressing calamities that a feeling community can possibly be subjected to.

Brighton, Mass, May 27, 1825

NOTICE TO CONTRACTORS FOR EXCAVATION AND EMBANKMENT.

Proposals will be received at the Office of the Munroe Railroad Company, Macon, Geo., between the 19th and 21st of May next, for Excavating and Embanking the whole of the Railroad from Macon to Forsyth, a distance of 25 miles, embracing much heavy graduation.

For further information, apply to

DANIEL GRIFFIN,
Resident Engineer.
J. EDGAR THOMSON,
C. Engineer.

Macon, March 28th, 1836. 11—5t

ALBANY EAGLE AIR FURNACE AND MACHINE SHOP.

WILLIAM V. MANY manufactures to order, IRON CASTINGS for Gearing Mills and Factories of every description.

ALSO—Steam Engines and Railroad castings of every description.

The collection of Patterns for Machinery, is not equalled in the United States. 9-1y

ARCHIMEDES WORKS.

(100 North Moor st. N Y.)

NEW YORK, February 12th, 1836

The undersigned begs leave to inform the proprietors of Railroads that they are prepared to furnish all kinds of Machinery for Railroads, Locomotive Engines of any size, Car Wheels, such as are now in successful operation on the Camden and Amboy Railroad, none of which have failed—Castings of all kinds, Wheels, Axles, and Boxes, furnished at shortest notice.

H. R. DUNHAM & CO.
4—ytf

SMITH & VALENTINE,

STEREOTYPE FOUNDERS,

Are prepared to execute orders in their line, at 212 Grand street, New-York

TO BRIDGE BUILDERS.

Sealed Proposals will be received, until the 15th of April, for finding materials and building the superstructure of a bridge, over Harlem Creek and flats, on the New York and Harlem Railroad.

Said Bridge to be on the late improvement of Mr. Town, 24 feet wide in the clear, and 660 feet long between the abutments, to be supported by three piers of masonry. The bridge to be completed by the 1st of Nov. ensuing. Communications may be addressed to the undersigned, at his office, No. 9 Chambers street, where plans and specifications may be seen.

JOHN EWEN, JR.
Engineer of the New York and Harlem Railroad.
9-t15a

TO CONTRACTORS.

NOTICE is hereby given to all persons who may feel disposed to take Contracts on the Illinois and Michigan Canal, that the Board of Commissioners have determined to commence that work as early in the spring as circumstances will permit. The Engineers will commence their surveys about the 10th of March, and will have several Sections ready for contract by the first of May. It is therefore expected that definite proposals will be received from that date to the first of June. In the mean time the Board invite an early inspection of that part of the route to Chicago, and will afford any information that may be required of them.

All communications will be addressed to "The Board of Commissioners of the Illinois and Michigan Canal, at Chicago."

By order of the Board.
JOEL MANNING, Secretary.

January 20, 1836. 8-6t

AMES' CELEBRATED SHOVELS, SPADES, &c.

300	dozens	Ames' superior back-strap Shovels			
150	do	do	do	plain	do
150	do	do	do	cast steel Shovels & Spades	
150	do	do	Gold-mining Shovels		
100	do	do	plated Spades		
50	do	do	socket Shovels and Spades.		

Together with Pick Axes, Churn Drills, and Crow Bars (steel pointed), manufactured from Salisbury refined Iron—for sale by the manufacturing agents,

WITHERELL, AMES & CO.
No. 2 Liberty street, New-York.
BACKUS, AMES & CO.
No. 8 State street, Albany.

N. B.—Also furnished to order, Shapes of every description, made from Salisbury refined Iron. 4—ytf

PATENT RAILROAD, SHIP AND BOAT SPIKES.

☞ The Troy Iron and Nail Factory keeps constantly for sale a very extensive assortment of Wrought Spikes and Nails, from 3 to 10 inches, manufactured by the subscriber's Patent Machinery, which after five years successful operation, and now almost universal use in the United States, (as well as England, where the subscriber obtained a patent,) are found superior to any ever offered in market.

Railroad Companies may be supplied with Spikes having countersink heads suitable to the holes in iron rails, to any amount and on short notice. Almost all the Railroads now in progress in the United States are fastened with Spikes made at the above named factory—for which purpose they are found invaluable, as their adhesion is more than double any common spikes made by the hammer.

☞ All orders directed to the Agent, Troy, N. Y., will be punctually attended to.

HENRY BURDEN, Agent.

Troy, N. Y., July, 1831.

☞ Spikes are kept for sale, at factory prices, by I. & J. Townsend, Albany, and the principal Iron Merchants in Albany and Troy; J. I. Brower, 222 Water street, New-York; A. M. Jones, Philadelphia; T. Janviers, Baltimore; Degrand & Smith, Boston.

P. S.—Railroad Companies would do well to forward their orders as early as practicable, as the subscriber is desirous of extending the manufacturing so as to keep pace with the daily increasing demand for his Spikes.

J23am H. BURDEN.

RAILROAD CAR WHEELS AND BOXES, AND OTHER RAILROAD CASTINGS.

☞ Also, AXLES furnished and fitted to wheels complete at the Jefferson Cotton and Wool Machine Factory and Foundry Paterson, N. J. All orders addressed to the subscribers at Paterson, or 60 Wall street, New-York, will be promptly attended to.

Also, CAR SPRINGS.

Also, Flange Tires turned complete.

J8 ROGERS, KETCHUM, & GROSVENOR.

STEPHENSON,

Builder of a superior style of Passenger Cars for Railroad.

No. 264 Elizabeth street, near Bleecker street, New-York.

☞ RAILROAD COMPANIES would do well to examine these Cars; a specimen of which may be seen on that part of the New York and Harlæm Railroad now in operation. J25tf

☞ THE NEWCASTLE MANUFACTURING COMPANY, incorporated by the State of Delaware, with a capital of 200,000 dollars, are prepared to execute in the first style and on liberal terms, at their extensive Finishing Shops and Foundries for Brass and Iron, situated in the town of Newcastle, Delaware, all orders for LOCOMOTIVE and other Steam Engines, and for CASTINGS of every description in Brass or Iron. RAILROAD WORK of all kinds finished in the best manner, and at the shortest notice.

Orders to be addressed to
MR. EDWARD A. G. YOUNG,
Superintendent, at Newcastle, Delaware.

feb 20—ytf

PROPOSALS FOR THE REPUBLICATION OF THE REPORTS OF THE BALTIMORE AND OHIO RAILROAD COMPANY;

Condensed so as to include, together with other matter added thereto, all that is known at the present day of the location and the application of Motive Power and Machinery thereupon, accompanied with explanatory drawings. The whole being intended to serve as a Manual of the Railroad System, for the use of Civil Engineers, to which is prefixed a history of the Baltimore and Ohio Railroad Company.

The work, whose reports it is thus intended to republish, was the first of any extent commenced in this country for the purposes of general transportation; and its early history is but a series of experiments, costly to the Company which had it in charge, but furnishing results of the greatest value and importance to others. The character of the country through which the road passed, involved every species of excavation; and in the construction of the Railway, almost every mode was successively tried for the purpose of ascertaining the best. While portions of the road were straight, others were of the smallest admissable curvature, and the locomotive power employed had to be such, therefore, as was suitable to both cases. This led to a series of experiments in this department of the Railroad System, which has resulted in the production of Engines preferable to any in use elsewhere—equal in speed to the best imported, and far superior in efficient power. From all these circumstances, the reports of the Baltimore and Ohio Railroad, from its commencement to the present day, have been sought for by Civil Engineers for the sake of the knowledge which they contain, and the frequent demand for them has suggested to the subscriber their republication, with such additional matter as shall constitute a Manual of the Railroad System in the present state of knowledge on the subject.

The reports are now difficult to be procured, and but few complete sets are known to be in existence. While the proposed republication will therefore be of use to the profession of Civil Engineering, it will be the means also of preserving the records of a work whose importance and value are now universally appreciated. The work will be divided into five parts.

I. History of the Baltimore and Ohio Railroad Company.

II. The location of Railroads, including the principles of reconnoissances, general instrumental surveys, and location for construction.

III. The construction of Railroads, including the excavation and masonry and the construction of the Railway on the graduated surface, turnouts, weighing, &c.

IV. The motive power including engines, cars, wagons, &c.

V. Forms of contracts for every species of work which has to be performed in the construction of a Railroad.

☞ As it is not practicable to ascertain what sized volume or volumes the contemplated work will make, the price cannot be fixed, but Railroad Companies and individuals who may subscribe for it, may rest assured, that it will be made as reasonable as the nature of it will permit. Orders directed to

F. LUCAS, Jr. Publisher,
Jan., 1836. No. 138 Market street, Baltimore.

RAILWAY IRON.

95	tons of 1 inch	by ½	inch,		
200	do.	1¼	do.	½	do.
40	do.	1½	do.	⅜	do.
800	do.	2	do.	½	do.
800	do.	2¼	do.	½	do.

soon expected.

FLAT BARS in lengths of 14 to 15 feet, counter sunk holes, ends cut at an angle of 45 degrees, with splicing plates and nails to suit.

250 do. of Edge Rails of 36 lbs. per yard, with the requisite chairs, keys and pins.

Wrought Iron Rims of 30, 33, and 36 inches diameter for Wheels of Railway Cars, and of 60 inches diameter for Locomotive Wheels.

Axles of 2½, 2¾, 2⅞, 3, 3¼, 3½ and 3¾ inches in diameter, for Railway Cars and Locomotives, of patent iron.

The above will be sold free of duty, to State Governments and Incorporated Governments, and the drawback taken in part payment.

A. & G. RALSTON,
9 South Front street, Philadelphia.

Models and samples of all the different kinds of Rails, Chairs, Pins, Wedges, Spikes, and Splicing Plates, in use both in this country and Great Britain, will be exhibited to those disposed to examine them. 4—d7 1meowr